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CLAIMS

[Claim(s)]
[Claim 1] A look-up table which stores color conversion information for expressing an image in a limited color A look-up table count means to input an image, to calculate color conversion information and to store said count result in said look-up table A subtractive color means which assigns either of said limited colors a color of each pixel which constitutes an input image with reference to a look-up table It is subtractive color equipment equipped with the above, and the classification Ruhr is the Ruhr which classifies each pixel of an input image according to a value of a color, and it is characterized by having a classification means to classify each pixel of an input image according to either of two or more attribute value using said classification Ruhr.
[Claim 2] Subtractive color equipment according to claim 1 characterized by having a color number count means to calculate the color number assigned to a pixel group which classifies each pixel which constitutes an input image from a classification means according to said attribute value, and by which attribute value is constituted from same pixel based on a result of said classification about each attribute value.
[Claim 3] Said classification Ruhr is subtractive color equipment according to claim 1 or 2 characterized by inputting a value of saturation and lightness at least among elements which constitute a color, and including the Takaaki saturation pixel detection Ruhr which outputs any one of the attribute value.
[Claim 4] Subtractive color equipment according to claim 1 to 3 characterized by having a filter means to perform filtering using a square filter.
[Claim 5] A two-dimensional square filter 1 is subtractive color equipment according to claim 1 to 4 which is the filter which inputs an image into said filter and makes highest input value of frequency an output signal of this filter, and is characterized by performing filtering with a filter means using said square filter 1 to a processing result in a subtractive color means.
[Claim 6] A two-dimensional square filter 2 is an edge extract filter constituted so that an output signal of said square filter to an input image might be acquired as edge information on said input image. Change an input image into monochrome shade image with at least two or more gradation, and said conversion result is received. Subtractive color equipment according to claim 1 to 4 characterized by having an edge extract means to perform processing which performs filtering processing with a filter means using said square filter 2, and extracts an edge component from this input image.
[Claim 7] an image of two sheets -- inputting -- this -- a result of having compared a color of the points of the same coordinate location of an image of two sheets -- responding -- a color after superposition -- calculating -- this -- subtractive color equipment according to claim 6 characterized by equipping a pixel of this coordinate location of an image of one sheet of either of the images of two sheets with a superposition means to overwrite said calculated color.
[Claim 8] A look-up table stores color conversion information for expressing an image in a limited color. The 1st step into which the classification Ruhr is the Ruhr which classifies each pixel of an input image according to a value of a color, and each pixel of an input image is classified according to either of two or more attribute value using said classification Ruhr, The 2nd step which calculates the color number assigned to a pixel group by which attribute value is constituted from same pixel based on a processing result in said 1st step about each attribute value, The 3rd step which inputs an

image, calculates color conversion information and stores said count result in said look-up table, A subtractive color method which includes the 4th step which assigns either of said limited colors a color of each pixel which constitutes an input image with reference to a look-up table, and the 5th step which performs filtering using a square filter.

[Claim 9] A subtractive color method according to claim 8 characterized by performing filtering processing at said 5th step using a square filter 1 according to claim 5 to a processing result in said 4th step.

[Claim 10] In a subtractive color method according to claim 8, an input image is further changed into monochrome shade image with at least two or more gradation. The 6th step which performs filtering processing in the 5th step using a square filter 5 according to claim 6 to said processing result, and extracts an edge component from this input image, an image of two sheets -- inputting -- this -- a result of having compared a color of the points of the same coordinate location of an image of two sheets -- responding -- a color after superposition -- calculating -- this -- a subtractive color method which includes the 7th step which overwrites said calculated color in a pixel of this coordinate location of an image of one sheet of either of the images of two sheets.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention decreases intentionally the color number of the full color image outputted in image output means, such as a display means and a printing means, and it relates to the subtractive color equipment which left the aesthetic property of a subject-copy image and which creates the color picture of the illustration style, and its subtractive color method, removing a reality.
[0002]
[Description of the Prior Art] Generally, with the combination of red (R), green (G), and blue (B), the equipment which displays an image expresses pixel data and displays it. With the equipment which displays the image called especially a full color image, generally, per pixel, since the frame buffer has the memory space for storing red (R), green (G), and the image data in which blue (B) lightness has 8 bits (= 256) gradation, it is possible to display the full color image of high degree of accuracy.
[0003] However, in almost all workstations, a personal computer, etc., since the frame buffer does not have only the memory space which indicates the full color image by coincidence, the method of displaying the full color image of an input in false using the color which can be expressed as a display means is used. Although the processing which changes the color of each pixel of a full color image into the color which can be expressed as a display means is needed for that purpose, as the method of the processing, it is large and there are two of the methods using the statistical distribution of the method and color using - dither matrix. Hereafter, the two above-mentioned methods are explained briefly.
[0004] 1) the method using a dither matrix -- in order are not conspicuous and to carry out the border line of the false which produces simply the pixel of the color which cannot express an input image when the number of gradation is reduced, this is the method of adding a noise intentionally, and when the method using a dither matrix is classified according to the algorithm of processing, it has the following two methods.
[0005] - Don't take into consideration the color of the method of determining the color of the pixel concerned in consideration of the color of the circumference pixel of the pixel concerned etc., and the circumference pixel of the pixel concerned. The statistic of color distribution of the method input image which carries out subtractive color of the dither matrix prepared beforehand to an input image using the statistical distribution of method 2 color which determines the color of superposition each pixel is calculated. The optimal N color (N: the number of the arbitration below the maximum of a color reproducible [with a display means]) for reproducing an input image is calculated, and a look-up table is created. and -- each pixel of an input image -- a look-up table and - if there is the same color -- the color - by changing, full color image data is changed into the color which can be expressed as a display means, and is displayed on the color most resembled in the look-up table when there was no same color.
[0006] In addition, the method of the above 1 is "JP,8-22273,A" etc., and the method of the above 2 is indicated in "JP,5-89972,A", "JP,5-215260,A", "a "image-analysis handbook", pp.505-516, University of Tokyo Press, 1991", etc.
[0007]

[Problem(s) to be Solved by the Invention] The place made into the purpose of this invention is creating the color picture of the illustration style which left the aesthetic property of a subject-copy image, inputting a full color image and removing a reality from this input image. For example, in animation, an illustration, etc., being expressed by the solid coating without gradation, ****** of animation and an illustration is [direction] stronger and a person's skin comes out rather than it is expressed by gradation using the gradation of a color. Therefore, when a full color image is inputted, it is desirable to repaint the gradation expression of this full color image in a single color as much as possible by subtractive color processing. For example, when the full color image of a person face is inputted, it is beige and a beige portion has the desirable thing with 2 thru/or 3 typical colors for which subtractive color can be carried out so that it can replace and express. And ****** of animation and an illustration is strengthened for the direction where the boundary of different colors is not expressed in the style of gradation using false gradation, but a boundary is expressed clearly.
[0008] If the effectiveness of the conventional subtractive color processing is considered in this viewpoint, since it is a method for reproducing the full color image of an input exactly as much as possible using a limited color, the not suitable method using the dither matrix of the above 1 is clear to the purpose of this invention first.
[0009] On the other hand, the method of carrying out subtractive color using the statistical distribution of the color of the above 2 is structure which reduces the color number by defining distance in the RGB color space which consists of red (R), green (G), and three blue (B) lightness shafts, and summarizing colors with said near distance in the color used as one representation. Namely, by the conventional method, if the number of foreground colors (temporarily referred to as M here) is specified It is what calculates the optimal distance in the RGB space for distinguishing by different color with in M color by scanning the whole full color image of an input, and performs conversion in the representation color of M pieces of each pixel of the input image according to the count / aforementioned distance of a -M piece representation color. Since the whole full color image of an input is scanned and M color of representation is decided, the gradation portion from which the color which said distance became large when setting up the value of M small, therefore was alike changes continuously can be replaced to some extent by the single color or two or more 2 or 3 colors.
[0010] It is a place, for example, on the whole, it is somber, and only mere a few considers the image with which ** and a kana portion exist. By such image, although even the time is impressively reflected to people's eyes, this ** and a kana portion By the conventional method, in an input image, few [operating frequency] colors Since it will be absorbed by either of said representation colors, the impression received from the subtractive color image which above ** and the color of a kana portion will be transposed to one of the representation colors [finishing / count], and was obtained as a result of processing has a high possibility of becoming a different thing from the impression received from an input image.
[0011] Therefore, even if only mere a few inputs the image with which ** and a kana portion exist as a technical problem which should be solved, it is offering the equipment which can perform subtractive color processing of an image, and its method, leaving the ** and kana portion.
[0012]
[Means for Solving the Problem] In order to solve this technical problem, subtractive color equipment by this invention A look-up table which stores color conversion information for expressing an image in a limited color, A classification means to classify each pixel of an input image according to either of two or more attribute value using the classification Ruhr which classifies each pixel of an input image according to a value of a color, and said classification Ruhr, A color number count means to calculate the color number assigned to a pixel group which classifies each pixel which constitutes an input image from a classification means according to said attribute value, and by which attribute value is constituted from same pixel based on a result of said classification about each attribute value, A look-up table count means to input an image, to calculate color conversion information and to store said count result in said look-up table, It is characterized by providing a subtractive color means which assigns either of said limited colors a color of each pixel which constitutes an input image as a main component with reference to a look-up table.
[0013] Moreover, the 1st step into which a subtractive color method by this invention classifies each

pixel of an input image according to either of two or more attribute value using said classification Ruhr, The 2nd step which calculates the color number assigned to a pixel group by which attribute value is constituted from same pixel based on a processing result in said 1st step about each attribute value, The 3rd step which inputs an image, calculates color conversion information and stores said count result in said look-up table, It is characterized by including the 4th step which assigns either of said limited colors a color of each pixel which constitutes an input image, and the 5th step which performs filtering using a square filter with reference to a look-up table.
[0014] In this invention, the color number assigned to a pixel group which classified each pixel of an input image according to either of two or more attribute value and has the same attribute value in each to each attribute value with reference to a classification result with a color number count means with a classification means first continuously, referring to the classification Ruhr is calculated.
[0015] With a look-up table count means, with reference to a processing result of said color number count means, a look-up table corresponding to each is created, finally, with reference to said look-up table, color conversion of each pixel of an input image is performed, and a desired subtractive color processing image is obtained with a subtractive color means about each attribute value.
[0016]
[Embodiment of the Invention] Hereafter, one example of this invention is explained using a drawing. Drawing 1 is the block diagram having shown the configuration of the subtractive color equipment of this invention according to claim 1.
[0017] The look-up table which stores color conversion information for the subtractive color equipment by this invention to express an image in a limited color as a main component (105), The classification Ruhr which classifies each pixel of an input image according to the value of a color (102), A classification means to classify each pixel of an input image according to either of two or more attribute value using the classification Ruhr (102) (101), Each pixel which constitutes an input image from a classification means (101) is classified according to said attribute value. A color number count means to calculate the color number assigned to the pixel group by which attribute value is constituted from same pixel based on the result of said classification about each attribute value (103), A look-up table count means to input an image, to calculate color conversion information and to store said count result in a look-up table (105) (104), An input means to be characterized by having the subtractive color means (106) which assigns either of said limited colors the color of each pixel which constitutes an input image with reference to a look-up table (105), and to input an image further (108), It has the configuration which consists of a filter means (107) to perform filtering using a square filter, and a display means (109) to display an image.
[0018] Hereafter, each component which constitutes this invention is explained. Drawing 2 - drawing 4 are the conceptual diagrams having shown the example of a configuration of a look-up table (105) needed in processing at large [in this invention]. first, the look-up table (105) shown in drawing 2 -- red (R) -- green -- it is an example in case the lightness of (G) and blue (B) has 8 bits (= 256) gradation. In this example, the numeric value which buries 8 bits of RGB at a time from a high order in this order, and is expressed with a total of 3 bytes is made into the table number (it corresponds to the element number as used in the field of 201 and an array) of a look-up table (105), and the configuration that the data of the color which should actually be replaced is stored in that array element (202) is taken.
[0019] For example, in the example of drawing 2 , if the value of (R, G, B) becomes (0x01, 0x01, 0x01) If it will be set to 0x010101 if this is collectively expressed by 3 bytes, and further 0x010101 is changed into decimal system Since the data which will call it the data of the 65793rd array element and is stored there is 0x000000, if there is data of the above (0x01, 0x01, 0x01) Replacing by (0x00, 0x00, 0x00) can read this data in the look-up table (105) of drawing 2 .
[0020] However, if red (R), green (G), and the look-up table (105) in which blue (B) lightness has 8 bits (= 256) gradation are created as mentioned above, it will pose a problem that the memory space which stores this look-up table (105) becomes great. For example, 3 bytes per color of data which stores the data after color conversion is required, and since this data array size becomes a part for the color number, i.e., 16777216 pieces, it is not suitable for mounting in the example of drawing 2 , in respect of memory space, processing speed, etc.
[0021] Then, red (R), green (G), the look-up table (105) that dropped blue (B) lightness to gradation

(4 thru/or 5 bits) are used in fact. The lightness of drawing 3 of red (R), green (G), and blue (B) is the example of the look-up table (105) of a 4-bit case, and the size of a look-up table (105) can be managed with 4096 pieces in this case.
[0022] Moreover, drawing 4 is the look-up table (105) constituted so that still more nearly required memory space could be lessened, when the color number after subtractive color is less than 256 colors (= 1 byte). In this example, it is made the line number (203) of the conversion table (it is especially called a color palette here) which does not write that color in the portion which writes in the color after the subtractive color in the conventional look-up table (105) directly, but has actually written that color data in it. If it carries out like this, the size of the location which writes in the color after the subtractive color of a look-up table (105) will end by 1 byte. Although it is necessary to prepare a color palette independently, considering the sum total of required memory, it is clear that the way which creates a color palette independently can be managed with small memory space.
[0023] This classification Ruhr (102) is the Ruhr which classifies each pixel of an input image according to the value of the color of this pixel about a certain pixel, for example, it seems for the classification means (101) by this invention to classify each pixel of an input image according to either of two or more attribute value using the classification Ruhr (102) by this invention, and to show it in the following examples. However, saturation shall be expressed with s, lightness shall be expressed with v, and each of s and v shall take the value of the range of 0-255 here.
[0024] In addition, the processing in a classification means (101) is equivalent to the processing of the 1st of a step in the subtractive color method of this invention according to claim 8.
[0025] Example: "about a certain pixel, the value of s of the pixel concerned and v is calculated, or (144 or more [And the value of v or more by 128]) if the value of (v is or more 224), the value of A, otherwise, attribute value will be set to B for the value of the attribute value of the pixel concerned" of the classification Ruhr. [s]
[0026] In addition, the classification Ruhr (102) used in the above-mentioned example is usable also as one example of the Takaaki saturation pixel detection Ruhr of this invention according to claim 3. Below, the above-mentioned example is called classification Ruhr (1).
[0027] Then, the flow of processing with a classification means (101) is explained according to drawing 5 . Drawing 5 is a flow chart which shows the flow of processing with the classification means (101) by this invention.
[0028] (301a) Initialize a look-up table (105) with values other than the value used as attribute value.

[0029] (302a) Take out 1 pixel of the arbitration which attribute value has not determined yet in an input image, and the classification Ruhr (102) determines the attribute value of the pixel concerned.
[0030] (303a) Write in the attribute value determined as the look-up table (105) corresponding to the color of the pixel concerned.
[0031] (304a) About all the pixels of an input image, if the above (302a) of - (303a) and processing are completed, processing with a classification means (101) will be ended. Moreover, if it has not ended, return (302a) - (303a) processing will be repeated to (302a).
[0032] In addition, drawing 6 is the example of the concrete processing flow at the time of applying classification Ruhr (1) in drawing 5 . Since the contents of the flow of processing are the same as drawing 5 , explanation is omitted.
[0033] The color number count means (103) by this invention calculates the color number assigned to the pixel group by which attribute value is constituted from same pixel about each attribute value based on the result into which each pixel which constitutes an input image was classified according to the classification means (101). Drawing 7 is what showed the example of the flow of the processing in the color number count means (103) by this invention in the form of the flow chart, and explains the example of processing in a color number count means (103) according to drawing 7 . In addition, the processing in a color number count means (103) is equivalent to the processing of the 2nd of a step in the subtractive color method of this invention according to claim 8.
[0034] (401) Input the color number N after subtractive color. Moreover, the number of the attribute value classified according to the classification means (101) is investigated by referring to a look-up table (105). Here, on account of explanation, said number considers as k pieces, and sets attribute value of eye i (1 <=i<=k) watch to Ai.

[0035] (402) Calculate the sample size Hi of the i= 1, --, pixel group whose attribute value is Ai about k, and the degree [group / whose attribute value is Ai / pixel] Vi of scatter.
[0036] Although many things are considered by said count method of Vi, here For example, a pixel is decomposed into the component of the color of red (R), green (G), and blue (B). Although distribution was calculated in the parameter space out of which red (R), green (G), and blue (B) come, respectively, as long as the scatter of the pixel group in a color space, such as considering as the value of Vi it being also at total value, is reflected, the count method of Vi may be what kind of thing.
[0037] (403) Calculate the color number nickel assigned to the i= 1, --, pixel group the value of Hi and the value of Vi to whose attribute value is Ai about k.
[0038] Here, although many things are considered by the count method of nickel, as a statement of principles, when the - frequency Hi is large, it is large in the value of nickel, and the value of nickel is made small when Hi is small.
[0039] - When the degree Vi of scatter is large, it is large in the value of nickel, and when Vi is small, make the value of nickel small.
[0040] Then, it is thought that appropriate allocation of the color number can be performed. It is based on the above-mentioned plan, for example, is the next formula (1) nickel=Sqrt(Hi) xVi. Formula (1)
nickel is normalized and it is thought that methods, such as obtaining target nickel, are effective so that nickel may be calculated with (however, the function with which Sqrt(x) returns the square root of x), then it may fill sigma(i= 1, --, k) nickel=N.
[0041] Although how to calculate the color number nickel above based on the sample size Hi of the pixel group whose attribute value is Ai, and the degree [group / whose attribute value is Ai / pixel] Vi of scatter was shown For example, methods, such as observing only the sample size Hi of the i= 1, --, pixel group whose attribute value is Ai about k, and deciding the value of nickel by the ratio of the square root more simply, may be used to make processing cost small as much as possible with equipment with slow processing speed.
[0042] Namely, the following formula (2), nickel=Sqrt (Hi) Formula (2)
nickel is normalized and it is thought that methods, such as obtaining target nickel, are effective so that nickel may be calculated with (however, the function with which Sqrt(x) returns the square root of x), then sigma(i= 1, --, k) nickel=N may be filled.
[0043] In addition, in count of nickel, though which of the above-mentioned formula (1) or a formula (2) is used, the value of Hi affects nickel, but when Hi is sufficiently small, it becomes meaningless to give one or more values to nickel. In that case, the i-th attribute value is good to transpose to one of the other attribute value with a certain means. In for example, the condition which should be divided into two attributes by a certain classification Ruhr (102) The total of the pixel according to which the total of the pixel classified into one one of attributes was classified into the attribute of another side, When the result of not filling to 0.3% is brought, all pixels by for example, the reason for hitting an example of the above-mentioned replacement of making it the same attribute value etc. According to the classification result, when additional processing like this example is required, additional processing doubles required conditions and the contents of said additional processing, and should just describe them to the classification Ruhr (102) (refer to the following example).
[0044] Example: "about a certain pixel, the value of s of the pixel concerned and v is calculated, or (144 or more [And the value of v or more by 128]) if the value of (v is or more 224), the value of A, otherwise, attribute value will be set to B for the value of the attribute value of the pixel concerned" which added processing of classification Ruhr (1). [s]
[0045] Moreover, after classification processing, if the rate that the pixel of A occupies [- attribute value which performs the following 2 processings if needed] is 0.3% or less of ******, attribute value changes all the attribute value of the pixel of A into B.
[0046] - If the rate that the pixel of B occupies [attribute value] is 0.3% or less of ******, attribute value changes all the attribute value of the pixel of B into A.
[0047] The look-up table count means (104) by this invention calculates the representation color of the pixel group by which attribute value is constituted from a pixel with the same attribute value based on the color number assigned to the pixel group which consists of same pixels, and stores said

count result in a look-up table (105).
[0048] Drawing 8 is the flow chart which shows the example of the flow of the processing in the look-up table count means (104) by this invention, and explains the example of processing in a look-up table count means (104) according to drawing 8 . In addition, the processing in a look-up table count means (104) is equivalent to the processing of the 3rd of a step in the subtractive color method of this invention according to claim 8.
[0049] (501) Calculate the distance Di which judges whether it is the color to which attribute value was similar in the color space for the pixel group which is Ai from the color number nickel assigned to the pixel group whose value and attribute value of sample size Hi of the i= 1, --, pixel group whose attribute value is Ai about k are Ai.
[0050] Various methods are indicated about the count method of Di. For example, it is thought that the distance defined as pp.513-514 of the above-mentioned reference "a "image-analysis handbook"" by the method by cube maximum dense arrangement of an indication is one of the distance definitions suitable for this method.
[0051] (502) Calculate the representation color of nickel individual to the i= 1, --, pixel group whose attribute value is Ai about k based on said distance Di. Although indicated also about the algorithm which selects this representation color by the method by legislation maximum dense arrangement of an indication in the above-mentioned reference, it is possible to apply said algorithm to selection of the representation color in this processing. in addition, the thing for which the count for which it opted is repeated with said algorithm -- although the method of determining a more suitable representation color is indicated, it is possible to obtain the result at which performing once said count for which it opted also maintained the quality of a degree to make processing cost small as much as possible with equipment with slow processing speed.
[0052] (503) Calculate in which representation color of each i= 1, --, pixel nickel individual whose attribute value is Ai about k it replaces based on the distance in a color space, write a result in a look-up table (105), and end processing with a look-up table count means (104).
[0053] The subtractive color means (106) by this invention performs processing which assigns either of said limited colors the color of each pixel which constitutes an input image with reference to a look-up table (105). Drawing 9 is the example which showed briefly the flow of processing with the subtractive color means (106) by this invention with the flow chart, and explains briefly the flow of processing with a subtractive color means (106) according to drawing 9 . In addition, the processing in a subtractive color means (106) is equivalent to the processing of the 4th of a step in the subtractive color method of this invention according to claim 8.
[0054] (601) Take out 1 pixel of the arbitration which omits color conversion yet in the input image, and rewrite the color of the pixel concerned by the color after the conversion currently written there with reference to the portion of the color corresponding to the pixel concerned of the pixel of a look-up table (105) concerned.
[0055] (602) About all the pixels of an input image, if processing of the above (601) is completed, processing with a subtractive color means (106) will be ended. Moreover, processing of (601) will be repeated if it has not ended.
[0056] Next, the flow of the whole subtractive color processing by the subtractive color equipment and the subtractive color method by this invention is explained according to the flow chart of drawing 10 . Moreover, drawing 11 shows signs that the contents of the look-up table (105) write and it changes as processing progresses. in addition, this example -- the red (R) of the color data of each pixel of an input image -- green -- (G) and blue (B) -- each lightness -- 4 bits (= 16) gradation -- having -- the classification Ruhr of the above-mentioned [the classification Ruhr (102)] -- it is about the case where (1) is used.
[0057] (701) Input an image with an input means (108) and initialize a look-up table (105). Drawing 11 (a) shows the condition that the look-up table (105) was initialized.
[0058] (702) With a classification means (101), classify each pixel of an input image according to either of two or more attribute value, referring to the classification Ruhr (102), and overwrite the result at a look-up table (105) (drawing 11 (b)). In addition, this example is the case where above-mentioned classification Ruhr (1) is used as an example of the classification Ruhr (102).
[0059] (703) Investigate two or more [the number of the attribute value according to which it was

classified with the classification means (101)] by referring to a look-up table (105) with a color number count means (103). This number is set to k. If it is k= 1, and it becomes k>1 about the following processing (704) - (705), the following processing (706) - (708) will be performed. In said classification Ruhr (1), since it is the Ruhr which classifies a pixel into two kinds of attribute value, A and B, it is set to k= 2.

[0060] In addition, since it is technology well-known about the configuration method of the look-up table (105) in the following processings (705), below, signs that a look-up table (105) is reconfigurated and the contents are rewritten perform explanation using drawing 11 (c, d) only in processing of (707).

[0061] (704) With a look-up table count means (104), calculate the representation color for the color number after the subtractive color processing specified beforehand, and complete a look-up table (105). In the case of k= 1, a look-up table (105) turns into a look-up table (105) of the usual format, as drawn on drawing 4 .

[0062] (705) Rewrite the color of each pixel which constitutes an input image from a subtractive color means (106) with reference to a look-up table (105) by the color to which said limited color is equivalent.

[0063] (706) Calculate the color number assigned to the pixel group by which attribute value is constituted from same pixel with a color number count means (103) based on the result into which each pixel which constitutes an input image was classified according to the classification means (101) about each attribute value. Here, the color number to which the color number temporarily assigned to A was assigned by Na and B is set to Nb.

[0064] (707) With a look-up table count means (104), create the look-up table (105) corresponding to each attribute value, calculate the representation color for the color number after subtractive color to coincidence, and complete a look-up table (105). In the example of drawing 11 (c), two look-up tables (105) corresponding to attribute value A and B are created. Moreover, size (size of an array) also creates the color palette (drawing 11 (d)) of Na and Nb to coincidence. And about attribute value A, the representation color for Nb is calculated and the look-up table (105) corresponding to each is completed [attribute value / B / for Na].

[0065] (708) Rewrite the color of each pixel which constitutes an input image from a subtractive color means (106) by the color to which said limited color is equivalent with reference to the look-up table (105) corresponding to the attribute value A and B of said pixel.

[0066] (709) If it is necessity, filtering, such as noise rejection, will be performed to the image after subtractive color processing.

(710) Express a subtractive color image as a display means (109), and end subtractive color processing.

[0067] In addition, drawing 12 is the block diagram having shown the example of a configuration of the subtractive color equipment of this invention according to claim 7. With the subtractive color equipment of this invention according to claim 7, as drawing 12 has shown An edge extract means to use a filter means (107) and to extract the edge component of an input image further to the subtractive color equipment (drawing 1) of this invention according to claim 1 (110), By making it the configuration which added a superposition means (111) to have compared the lightness value of a pixel and to compound the image of two sheets, an edge image can be laid on top of the image which carried out subtractive color. In this case, what is necessary is to measure the lightness of the points of the same coordinate location of the inputted image of two sheets as the count method of the color after piling up an image, and just to use methods, such as making into the color of the pixel after superposition the color of the pixel of the one where lightness is lower, in a superposition means (111). It becomes possible to create automatically the image with which the effect of the animation style was given to an input image by this superposition processing.

[0068] in addition, processing [in / in the processing in a filter means (107) / the subtractive color method of this invention according to claim 8] of the 5th of a step -- moreover, the processing in said superposition means (111) is equivalent to the processing of the 7th of a step in the subtractive color method of this invention according to claim 10, respectively.

[0069] Drawing 13 shows the flow of the processing in the subtractive color equipment according to claim 7 and the subtractive color method according to claim 10 of this invention in the form of a

flow chart. After the whole processing performs processing (701) (- (710)) of subtractive color, and processing (711) of an edge extract in parallel (the point is sufficient as which processing), it lays the image of the processing result of subtractive color (701), and the image of an edge extract processing result on top of the last, and is completed. In addition, since the configuration method of an edge extract means (110) and the configuration method of the square filter used in that case are explained in full detail by Japanese Patent Application No. No. 81268 [eight to], explanation is omitted here. Moreover, since it is the same as the processing in the processing (701) in drawing 13 , and drawing 10 , - (710) omits explanation. Moreover, the processing in an edge extract means (110) is equivalent to the processing of the 6th of a step in the subtractive color method of this invention according to claim 10.

[0070]

[Effect of the Invention] By preparing the classification Ruhr according to a use and carrying out the analysis classification of the color distribution of an input image in this invention, using this classification Ruhr with a classification means for example, on the whole, it is somber and only mere a few about the image with which ** and a kana portion exist It could check how much existences [this ** or a kana portion] there are, and the processing which calculates the suitable color number assigned to this **, a kana portion, and the other portion by the processing result of said classification means with a color number count means is newly incorporated.

[0071] In the conventional subtractive color processing, since data with small frequency was statistically absorbed to the whole by data with large frequency, there was a problem that data with this small frequency will be lost by subtractive color processing, but by installation of this classification Ruhr, a classification means, and a color number count means, even if frequency was small, subtractive color [having left the required portion] processing was attained. For example, in the example of the above-mentioned image, it can realize that only mere a few performs subtractive color processing independently in **, a kana portion, and the other portion, and after subtractive color processing can leave ** and a kana portion as the result.

[Translation done.]

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TECHNICAL FIELD

[A technical field to which invention belongs] This invention decreases intentionally the color number of a full color image outputted in image output means, such as a display means and a printing means, and it relates to subtractive color equipment which left aesthetic property of a subject-copy image and which creates a color picture of the illustration style, and its subtractive color method, removing a reality.

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PRIOR ART

[Description of the Prior Art] Generally, with the combination of red (R), green (G), and blue (B), the equipment which displays an image expresses pixel data and displays it. With the equipment which displays the image called especially a full color image, generally, per pixel, since the frame buffer has the memory space for storing red (R), green (G), and the image data in which blue (B) lightness has 8 bits (= 256) gradation, it is possible to display the full color image of high degree of accuracy.
[0003] However, in almost all workstations, a personal computer, etc., since the frame buffer does not have only the memory space which indicates the full color image by coincidence, the method of displaying the full color image of an input in false using the color which can be expressed as a display means is used. Although the processing which changes the color of each pixel of a full color image into the color which can be expressed as a display means is needed for that purpose, as the method of the processing, it is large and there are two of the methods using the statistical distribution of the method and color using - dither matrix. Hereafter, the two above-mentioned methods are explained briefly.
[0004] 1) the method using a dither matrix -- in order are not conspicuous and to carry out the border line of the false which produces simply the pixel of the color which cannot express an input image when the number of gradation is reduced, this is the method of adding a noise intentionally, and when the method using a dither matrix is classified according to the algorithm of processing, it has the following two methods.
[0005] - calculate the statistic of color distribution of the method input image which carries out subtractive color of the dither matrix prepared beforehand to an input image using the statistical distribution of method 2 color which determines the color of superposition each pixel regardless of the color of the method of determining the color of the pixel concerned in consideration of the color of the circumference pixel of the pixel concerned etc., and the circumference pixel of the pixel concerned, and reproduce an input image Optimal N color (N: the number of the arbitration below the maximum of a color reproducible [with a display means]) is calculated, and a look-up table is created. and -- each pixel of an input image -- a look-up table and - if there is the same color -- the color - by changing, full color image data is changed into the color which can be expressed as a display means, and is displayed on the color most resembled in the look-up table when there was no same color.
[0006] In addition, the method of the above 1 is "JP,8-22273,A" etc., and the method of the above 2 is indicated in "JP,5-89972,A", "JP,5-215260,A", "a "image-analysis handbook", pp.505-516, University of Tokyo Press, 1991", etc.

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EFFECT OF THE INVENTION

[Effect of the Invention] preparing the classification Ruhr according to a use and carrying out the analysis classification of the color distribution of an input image in this invention, using this classification Ruhr with a classification means -- or [for example, / that only mere a few has existences / how much / of this ** and a kana portion by on the whole being somber about the image with which ** and a kana portion exist] -- it can check -- the processing result of said classification means The processing which calculates the suitable color number assigned to this **, a kana portion, and the other portion with a color number count means is newly incorporated.
[0071] In the conventional subtractive color processing, since data with small frequency was statistically absorbed to the whole by data with large frequency, there was a problem that data with this small frequency will be lost by subtractive color processing, but by installation of this classification Ruhr, a classification means, and a color number count means, even if frequency was small, subtractive color [having left the required portion] processing was attained. For example, in the example of the above-mentioned image, it can realize that only mere a few performs subtractive color processing independently in **, a kana portion, and the other portion, and after subtractive color processing can leave ** and a kana portion as the result.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The place made into the purpose of this invention is creating the color picture of the illustration style which left the aesthetic property of a subject-copy image, inputting a full color image and removing a reality from this input image. For example, in animation, an illustration, etc., being expressed by the solid coating without gradation, ****** of animation and an illustration is [direction] stronger and a person's skin comes out rather than it is expressed by gradation using the gradation of a color. Therefore, when a full color image is inputted, it is desirable to repaint the gradation expression of this full color image in a single color as much as possible by subtractive color processing. For example, when the full color image of a person face is inputted, it is beige and a beige portion has the desirable thing with 2 thru/or 3 typical colors for which subtractive color can be carried out so that it can replace and express. And ****** of animation and an illustration is strengthened for the direction where the boundary of different colors is not expressed in the style of gradation using false gradation, but a boundary is expressed clearly.
[0008] If the effectiveness of the conventional subtractive color processing is considered in this viewpoint, since it is a method for reproducing the full color image of an input exactly as much as possible using a limited color, the not suitable method using the dither matrix of the above 1 is clear to the purpose of this invention first.
[0009] On the other hand, the method of carrying out subtractive color using the statistical distribution of the color of the above 2 is structure which reduces the color number by defining distance in the RGB color space which consists of red (R), green (G), and three blue (B) lightness shafts, and summarizing colors with said near distance in the color used as one representation. Namely, by the conventional method, if the number of foreground colors (temporarily referred to as M here) is specified It is what calculates the optimal distance in the RGB space for distinguishing by different color with in M color by scanning the whole full color image of an input, and performs conversion in the representation color of M pieces of each pixel of the input image according to the count / aforementioned distance of a -M piece representation color. Since the whole full color image of an input is scanned and M color of representation is decided, the gradation portion from which the color which said distance became large when setting up the value of M small, therefore was alike changes continuously can be replaced to some extent by the single color or two or more 2 or 3 colors.
[0010] It is a place, for example, on the whole, it is somber, and only mere a few considers the image with which ** and a kana portion exist. By such image, although even the time is impressively reflected to people's eyes, this ** and a kana portion By the conventional method, in an input image, few [operating frequency] colors Since it will be absorbed by either of said representation colors, the impression received from the subtractive color image which above ** and the color of a kana portion will be transposed to one of the representation colors [finishing / count], and was obtained as a result of processing has a high possibility of becoming a different thing from the impression received from an input image.
[0011] Therefore, even if only mere a few inputs the image with which ** and a kana portion exist as a technical problem which should be solved, it is offering the equipment which can perform subtractive color processing of an image, and its method, leaving the ** and kana portion.

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MEANS

[Means for Solving the Problem] In order to solve this technical problem, subtractive color equipment by this invention A look-up table which stores color conversion information for expressing an image in a limited color, A classification means to classify each pixel of an input image according to either of two or more attribute value using the classification Ruhr which classifies each pixel of an input image according to a value of a color, and said classification Ruhr, A color number count means to calculate the color number assigned to a pixel group which classifies each pixel which constitutes an input image from a classification means according to said attribute value, and by which attribute value is constituted from same pixel based on a result of said classification about each attribute value, A look-up table count means to input an image, to calculate color conversion information and to store said count result in said look-up table, It is characterized by providing a subtractive color means which assigns either of said limited colors a color of each pixel which constitutes an input image as a main component with reference to a look-up table.
[0013] Moreover, the 1st step into which a subtractive color method by this invention classifies each pixel of an input image according to either of two or more attribute value using said classification Ruhr, The 2nd step which calculates the color number assigned to a pixel group by which attribute value is constituted from same pixel based on a processing result in said 1st step about each attribute value, The 3rd step which inputs an image, calculates color conversion information and stores said count result in said look-up table, It is characterized by including the 4th step which assigns either of said limited colors a color of each pixel which constitutes an input image, and the 5th step which performs filtering using a square filter with reference to a look-up table.
[0014] In this invention, the color number assigned to a pixel group which classified each pixel of an input image according to either of two or more attribute value and has the same attribute value in each to each attribute value with reference to a classification result with a color number count means with a classification means first continuously, referring to the classification Ruhr is calculated.
[0015] With a look-up table count means, with reference to a processing result of said color number count means, a look-up table corresponding to each is created, finally, with reference to said look-up table, color conversion of each pixel of an input image is performed, and a desired subtractive color processing image is obtained with a subtractive color means about each attribute value.
[0016]
[Embodiment of the Invention] Hereafter, one example of this invention is explained using a drawing. Drawing 1 is the block diagram having shown the configuration of the subtractive color equipment of this invention according to claim 1.
[0017] The look-up table which stores color conversion information for the subtractive color equipment by this invention to express an image in a limited color as a main component (105), The classification Ruhr which classifies each pixel of an input image according to the value of a color (102), A classification means to classify each pixel of an input image according to either of two or more attribute value using the classification Ruhr (102) (101), Each pixel which constitutes an input image from a classification means (101) is classified according to said attribute value. A color number count means to calculate the color number assigned to the pixel group by which attribute value is constituted from same pixel based on the result of said classification about each attribute value (103), A look-up table count means to input an image, to calculate color conversion information and to store said count result in a look-up table (105) (104), An input means to be

characterized by having the subtractive color means (106) which assigns either of said limited colors the color of each pixel which constitutes an input image with reference to a look-up table (105), and to input an image further (108), It has the configuration which consists of a filter means (107) to perform filtering using a square filter, and a display means (109) to display an image.
[0018] Hereafter, each component which constitutes this invention is explained. Drawing 2 - drawing 4 are the conceptual diagrams having shown the example of a configuration of a look-up table (105) needed in processing at large [in this invention]. first, the look-up table (105) shown in drawing 2 -- red (R) -- green -- it is an example in case the lightness of (G) and blue (B) has 8 bits (= 256) gradation. In this example, the numeric value which buries 8 bits of RGB at a time from a high order in this order, and is expressed with a total of 3 bytes is made into the table number (it corresponds to the element number as used in the field of 201 and an array) of a look-up table (105), and the configuration that the data of the color which should actually be replaced is stored in that array element (202) is taken.
[0019] For example, in the example of drawing 2 , if the value of (R, G, B) becomes (0x01, 0x01, 0x01) If it will be set to 0x010101 if this is collectively expressed by 3 bytes, and further 0x010101 is changed into decimal system Since the data which will call it the data of the 65793rd array element and is stored there is 0x000000, if there is data of the above (0x01, 0x01, 0x01) Replacing by (0x00, 0x00, 0x00) can read this data in the look-up table (105) of drawing 2 .
[0020] However, if red (R), green (G), and the look-up table (105) in which blue (B) lightness has 8 bits (= 256) gradation are created as mentioned above, it will pose a problem that the memory space which stores this look-up table (105) becomes great. For example, 3 bytes per color of data which stores the data after color conversion is required, and since this data array size becomes a part for the color number, i.e., 16777216 pieces, it is not suitable for mounting in the example of drawing 2 , in respect of memory space, processing speed, etc.
[0021] Then, red (R), green (G), the look-up table (105) that dropped blue (B) lightness to gradation (4 thru/or 5 bits) are used in fact. The lightness of drawing 3 of red (R), green (G), and blue (B) is the example of the look-up table (105) of a 4-bit case, and the size of a look-up table (105) can be managed with 4096 pieces in this case.
[0022] Moreover, drawing 4 is the look-up table (105) constituted so that still more nearly required memory space could be lessened, when the color number after subtractive color is less than 256 colors (= 1 byte). In this example, it is made the line number (203) of the conversion table (it is especially called a color palette here) which does not write that color in the portion which writes in the color after the subtractive color in the conventional look-up table (105) directly, but has actually written that color data in it. If it carries out like this, the size of the location which writes in the color after the subtractive color of a look-up table (105) will end by 1 byte. Although it is necessary to prepare a color palette independently, considering the sum total of required memory, it is clear that the way which creates a color palette independently can be managed with small memory space.
[0023] This classification Ruhr (102) is the Ruhr which classifies each pixel of an input image according to the value of the color of this pixel about a certain pixel, for example, it seems for the classification means (101) by this invention to classify each pixel of an input image according to either of two or more attribute value using the classification Ruhr (102) by this invention, and to show it in the following examples. However, saturation shall be expressed with s, lightness shall be expressed with v, and each of s and v shall take the value of the range of 0-255 here.
[0024] In addition, the processing in a classification means (101) is equivalent to the processing of the 1st of a step in the subtractive color method of this invention according to claim 8.
[0025] Example: "about a certain pixel, the value of s of the pixel concerned and v is calculated, or (144 or more [And the value of v or more by 128]) if the value of (v is or more 224), the value of A, otherwise, attribute value will be set to B for the value of the attribute value of the pixel concerned" of the classification Ruhr. [s]
[0026] In addition, the classification Ruhr (102) used in the above-mentioned example is usable also as one example of the Takaaki saturation pixel detection Ruhr of this invention according to claim 3. Below, the above-mentioned example is called classification Ruhr (1).
[0027] Then, the flow of processing with a classification means (101) is explained according to drawing 5 . Drawing 5 is a flow chart which shows the flow of processing with the classification

means (101) by this invention.
[0028] (301a) Initialize a look-up table (105) with values other than the value used as attribute value.

[0029] (302a) Take out 1 pixel of the arbitration which attribute value has not determined yet in an input image, and the classification Ruhr (102) determines the attribute value of the pixel concerned.
[0030] (303a) Write in the attribute value determined as the look-up table (105) corresponding to the color of the pixel concerned.
[0031] (304a) About all the pixels of an input image, if the above (302a) of - (303a) and processing are completed, processing with a classification means (101) will be ended. Moreover, if it has not ended, return (302a) - (303a) processing will be repeated to (302a).
[0032] In addition, drawing 6 is the example of the concrete processing flow at the time of applying classification Ruhr (1) in drawing 5 . Since the contents of the flow of processing are the same as drawing 5 , explanation is omitted.
[0033] The color number count means (103) by this invention calculates the color number assigned to the pixel group by which attribute value is constituted from same pixel about each attribute value based on the result into which each pixel which constitutes an input image was classified according to the classification means (101). Drawing 7 is what showed the example of the flow of the processing in the color number count means (103) by this invention in the form of the flow chart, and explains the example of processing in a color number count means (103) according to drawing 7 . In addition, the processing in a color number count means (103) is equivalent to the processing of the 2nd of a step in the subtractive color method of this invention according to claim 8.
[0034] (401) Input the color number N after subtractive color. Moreover, the number of the attribute value classified according to the classification means (101) is investigated by referring to a look-up table (105). Here, on account of explanation, said number considers as k pieces, and sets attribute value of eye i (1 <=i<=k) watch to Ai.
[0035] (402) Calculate the sample size Hi of the i= 1, --, pixel group whose attribute value is Ai about k, and the degree [group / whose attribute value is Ai / pixel] Vi of scatter.
[0036] Although many things are considered by said count method of Vi, here For example, a pixel is decomposed into the component of the color of red (R), green (G), and blue (B). Although distribution was calculated in the parameter space out of which red (R), green (G), and blue (B) come, respectively, as long as the scatter of the pixel group in a color space, such as considering as the value of Vi it being also at total value, is reflected, the count method of Vi may be what kind of thing.
[0037] (403) Calculate the color number nickel assigned to the i= 1, --, pixel group the value of Hi and the value of Vi to whose attribute value is Ai about k.
[0038] Here, although many things are considered by the count method of nickel, as a statement of principles, when the - frequency Hi is large, it is large in the value of nickel, and the value of nickel is made small when Hi is small.
[0039] - When the degree Vi of scatter is large, it is large in the value of nickel, and when Vi is small, make the value of nickel small.
[0040] Then, it is thought that appropriate allocation of the color number can be performed. It is based on the above-mentioned plan, for example, is the next formula (1) nickel=Sqrt(Hi) xVi. Formula (1)
nickel is normalized and it is thought that methods, such as obtaining target nickel, are effective so that nickel may be calculated with (however, the function with which Sqrt(x) returns the square root of x), then it may fill sigma(i= 1, --, k) nickel=N.
[0041] Although how to calculate the color number nickel above based on the sample size Hi of the pixel group whose attribute value is Ai, and the degree [group / whose attribute value is Ai / pixel] Vi of scatter was shown For example, methods, such as observing only the sample size Hi of the i= 1, --, pixel group whose attribute value is Ai about k, and deciding the value of nickel by the ratio of the square root more simply, may be used to make processing cost small as much as possible with equipment with slow processing speed.
[0042] Namely, the following formula (2), nickel=Sqrt (Hi) Formula (2)
nickel is normalized and it is thought that methods, such as obtaining target nickel, are effective so

that nickel may be calculated with (however, the function with which Sqrt(x) returns the square root of x), then sigma(i= 1, --, k) nickel=N may be filled.
[0043] In addition, in count of nickel, though which of the above-mentioned formula (1) or a formula (2) is used, the value of Hi affects nickel, but when Hi is sufficiently small, it becomes meaningless to give one or more values to nickel. In that case, the i-th attribute value is good to transpose to one of the other attribute value with a certain means. In for example, the condition which should be divided into two attributes by a certain classification Ruhr (102) The total of the pixel according to which the total of the pixel classified into one one of attributes was classified into the attribute of another side, When the result of not filling to 0.3% is brought, all pixels by for example, the reason for hitting an example of the above-mentioned replacement of making it the same attribute value etc. According to the classification result, when additional processing like this example is required, additional processing doubles required conditions and the contents of said additional processing, and should just describe them to the classification Ruhr (102) (refer to the following example).
[0044] Example: "about a certain pixel, the value of s of the pixel concerned and v is calculated, or (144 or more [And the value of v or more by 128]) if the value of (v is or more 224), the value of A, otherwise, attribute value will be set to B for the value of the attribute value of the pixel concerned" which added processing of classification Ruhr (1). [s]
[0045] Moreover, after classification processing, if the rate that the pixel of A occupies [- attribute value which performs the following 2 processings if needed] is 0.3% or less of ******, attribute value changes all the attribute value of the pixel of A into B.
[0046] - If the rate that the pixel of B occupies [attribute value] is 0.3% or less of ******, attribute value changes all the attribute value of the pixel of B into A.
[0047] The look-up table count means (104) by this invention calculates the representation color of the pixel group by which attribute value is constituted from a pixel with the same attribute value based on the color number assigned to the pixel group which consists of same pixels, and stores said count result in a look-up table (105).
[0048] Drawing 8 is the flow chart which shows the example of the flow of the processing in the look-up table count means (104) by this invention, and explains the example of processing in a look-up table count means (104) according to drawing 8 . In addition, the processing in a look-up table count means (104) is equivalent to the processing of the 3rd of a step in the subtractive color method of this invention according to claim 8.
[0049] (501) Calculate the distance Di which judges whether it is the color to which attribute value was similar in the color space for the pixel group which is Ai from the color number nickel assigned to the pixel group whose value and attribute value of sample size Hi of the i= 1, --, pixel group whose attribute value is Ai about k are Ai.
[0050] Various methods are indicated about the count method of Di. For example, it is thought that the distance defined as pp.513-514 of the above-mentioned reference "a "image-analysis handbook"" by the method by cube maximum dense arrangement of an indication is one of the distance definitions suitable for this method.
[0051] (502) Calculate the representation color of nickel individual to the i= 1, --, pixel group whose attribute value is Ai about k based on said distance Di. Although indicated also about the algorithm which selects this representation color by the method by legislation maximum dense arrangement of an indication in the above-mentioned reference, it is possible to apply said algorithm to selection of the representation color in this processing. in addition, the thing for which the count for which it opted is repeated with said algorithm -- although the method of determining a more suitable representation color is indicated, it is possible to obtain the result at which performing once said count for which it opted also maintained the quality of a degree to make processing cost small as much as possible with equipment with slow processing speed.
[0052] (503) Calculate in which representation color of each i= 1, --, pixel nickel individual whose attribute value is Ai about k it replaces based on the distance in a color space, write a result in a look-up table (105), and end processing with a look-up table count means (104).
[0053] The subtractive color means (106) by this invention performs processing which assigns either of said limited colors the color of each pixel which constitutes an input image with reference to a look-up table (105). Drawing 9 is the example which showed briefly the flow of processing with the

subtractive color means (106) by this invention with the flow chart, and explains briefly the flow of processing with a subtractive color means (106) according to drawing 9 . In addition, the processing in a subtractive color means (106) is equivalent to the processing of the 4th of a step in the subtractive color method of this invention according to claim 8.

[0054] (601) Take out 1 pixel of the arbitration which omits color conversion yet in the input image, and rewrite the color of the pixel concerned by the color after the conversion currently written there with reference to the portion of the color corresponding to the pixel concerned of the pixel of a look-up table (105) concerned.

[0055] (602) About all the pixels of an input image, if processing of the above (601) is completed, processing with a subtractive color means (106) will be ended. Moreover, processing of (601) will be repeated if it has not ended.

[0056] Next, the flow of the whole subtractive color processing by the subtractive color equipment and the subtractive color method by this invention is explained according to the flow chart of drawing 10 . Moreover, drawing 11 shows signs that the contents of the look-up table (105) write and it changes as processing progresses. in addition, this example -- the red (R) of the color data of each pixel of an input image -- green -- (G) and blue (B) -- each lightness -- 4 bits (= 16) gradation -- having -- the classification Ruhr of the above-mentioned [the classification Ruhr (102)] -- it is about the case where (1) is used.

[0057] (701) Input an image with an input means (108) and initialize a look-up table (105). Drawing 11 (a) shows the condition that the look-up table (105) was initialized.

[0058] (702) With a classification means (101), classify each pixel of an input image according to either of two or more attribute value, referring to the classification Ruhr (102), and overwrite the result at a look-up table (105) (drawing 11 (b)). In addition, this example is the case where above-mentioned classification Ruhr (1) is used as an example of the classification Ruhr (102).

[0059] (703) Investigate two or more [the number of the attribute value according to which it was classified with the classification means (101)] by referring to a look-up table (105) with a color number count means (103). This number is set to k. If it is k= 1, and it becomes k>1 about the following processing (704) - (705), the following processing (706) - (708) will be performed. In said classification Ruhr (1), since it is the Ruhr which classifies a pixel into two kinds of attribute value, A and B, it is set to k= 2.

[0060] In addition, since it is technology well-known about the configuration method of the look-up table (105) in the following processings (705), below, signs that a look-up table (105) is reconfigurated and the contents are rewritten perform explanation using drawing 11 (c, d) only in processing of (707).

[0061] (704) With a look-up table count means (104), calculate the representation color for the color number after the subtractive color processing specified beforehand, and complete a look-up table (105). In the case of k= 1, a look-up table (105) turns into a look-up table (105) of the usual format, as drawn on drawing 4 .

[0062] (705) Rewrite the color of each pixel which constitutes an input image from a subtractive color means (106) with reference to a look-up table (105) by the color to which said limited color is equivalent.

[0063] (706) Calculate the color number assigned to the pixel group by which attribute value is constituted from same pixel with a color number count means (103) based on the result into which each pixel which constitutes an input image was classified according to the classification means (101) about each attribute value. Here, the color number to which the color number temporarily assigned to A was assigned by Na and B is set to Nb.

[0064] (707) With a look-up table count means (104), create the look-up table (105) corresponding to each attribute value, calculate the representation color for the color number after subtractive color to coincidence, and complete a look-up table (105). In the example of drawing 11 (c), two look-up tables (105) corresponding to attribute value A and B are created. Moreover, size (size of an array) also creates the color palette (drawing 11 (d)) of Na and Nb to coincidence. And about attribute value A, the representation color for Nb is calculated and the look-up table (105) corresponding to each is completed [attribute value / B / for Na].

[0065] (708) Rewrite the color of each pixel which constitutes an input image from a subtractive

color means (106) by the color to which said limited color is equivalent with reference to the look-up table (105) corresponding to the attribute value A and B of said pixel.
[0066] (709) If it is necessity, filtering, such as noise rejection, will be performed to the image after subtractive color processing.
(710) Express a subtractive color image as a display means (109), and end subtractive color processing.
[0067] In addition, drawing 12 is the block diagram having shown the example of a configuration of the subtractive color equipment of this invention according to claim 7. With the subtractive color equipment of this invention according to claim 7, as drawing 12 has shown An edge extract means to use a filter means (107) and to extract the edge component of an input image further to the subtractive color equipment (drawing 1) of this invention according to claim 1 (110), By making it the configuration which added a superposition means (111) to have compared the lightness value of a pixel and to compound the image of two sheets, an edge image can be laid on top of the image which carried out subtractive color. In this case, what is necessary is to measure the lightness of the points of the same coordinate location of the inputted image of two sheets as the count method of the color after piling up an image, and just to use methods, such as making into the color of the pixel after superposition the color of the pixel of the one where lightness is lower, in a superposition means (111). It becomes possible to create automatically the image with which the effect of the animation style was given to an input image by this superposition processing.
[0068] in addition, processing [in / in the processing in a filter means (107) / the subtractive color method of this invention according to claim 8] of the 5th of a step -- moreover, the processing in said superposition means (111) is equivalent to the processing of the 7th of a step in the subtractive color method of this invention according to claim 10, respectively.
[0069] Drawing 13 shows the flow of the processing in the subtractive color equipment according to claim 7 and the subtractive color method according to claim 10 of this invention in the form of a flow chart. After the whole processing performs processing (701) (- (710)) of subtractive color, and processing (711) of an edge extract in parallel (the point is sufficient as which processing), it lays the image of the processing result of subtractive color (701), and the image of an edge extract processing result on top of the last, and is completed. In addition, since the configuration method of an edge extract means (110) and the configuration method of the square filter used in that case are explained in full detail by Japanese Patent Application No. No. 81268 [eight to], explanation is omitted here. Moreover, since it is the same as the processing in the processing (701) in drawing 13 , and drawing 10 , - (710) omits explanation. Moreover, the processing in an edge extract means (110) is equivalent to the processing of the 6th of a step in the subtractive color method of this invention according to claim 10.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram having shown the configuration of the gestalt of 1 operation of the subtractive color equipment of this invention according to claim 1
[Drawing 2] The conceptual diagram having shown the example of a configuration of the conventional look-up table
[Drawing 3] The conceptual diagram having shown the example of a configuration of the conventional look-up table
[Drawing 4] The conceptual diagram having shown the example of a configuration of the conventional look-up table
[Drawing 5] The flow chart which shows the flow of processing with the classification means by this invention
[Drawing 6] The flow chart which showed the flow of processing with the classification means by this invention based on the example of the classification Ruhr
[Drawing 7] The flow chart which shows the example of the flow of the processing in the color number count means by this invention
[Drawing 8] The flow chart which shows the example of the flow of the processing in the look-up table count means by this invention
[Drawing 9] The flow chart which shows the flow of processing with the subtractive color means by this invention
[Drawing 10] The flow chart which shows the flow of the whole subtractive color processing by the subtractive color equipment and the subtractive color method by this invention
[Drawing 11] The conceptual diagram having shown the example of a configuration of the look-up table by this invention
[Drawing 12] The block diagram having shown the example of a configuration of the subtractive color equipment of this invention according to claim 7
[Drawing 13] The flow chart which shows the flow of the processing in the subtractive color equipment according to claim 7 and the subtractive color method according to claim 10 of this invention
[Description of Notations]
101 Classification Means
102 Classification Ruhr
103 Color Number Count Means
104 Look-up Table Count Means
105 Look-up Table
106 Subtractive Color Means
107 Filter Means
108 Input Means
109 Display Means
110 Edge Extract Means
111 Superposition Means

[Translation done.]

* NOTICES *

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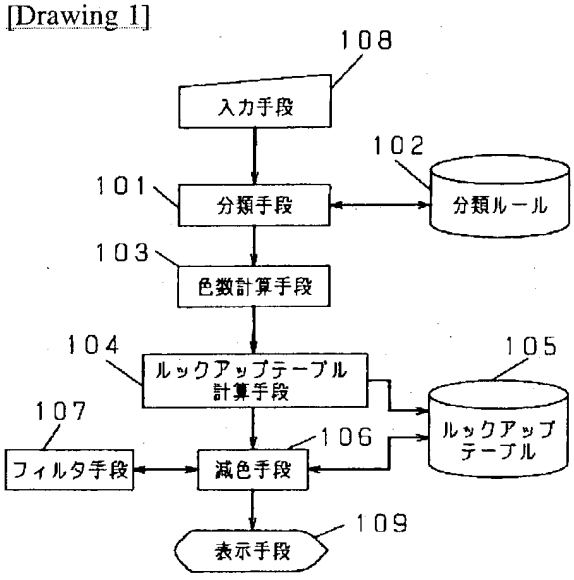
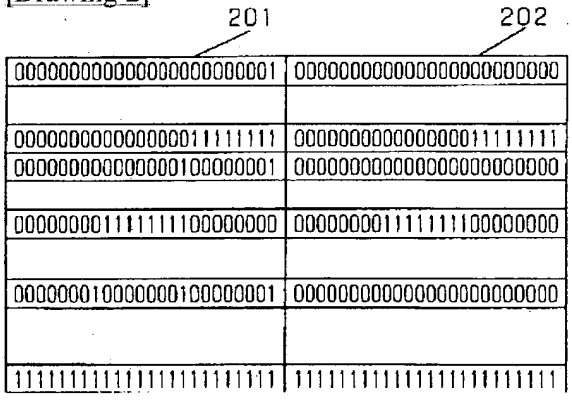
DRAWINGS

[Drawing 1]



[Drawing 2]



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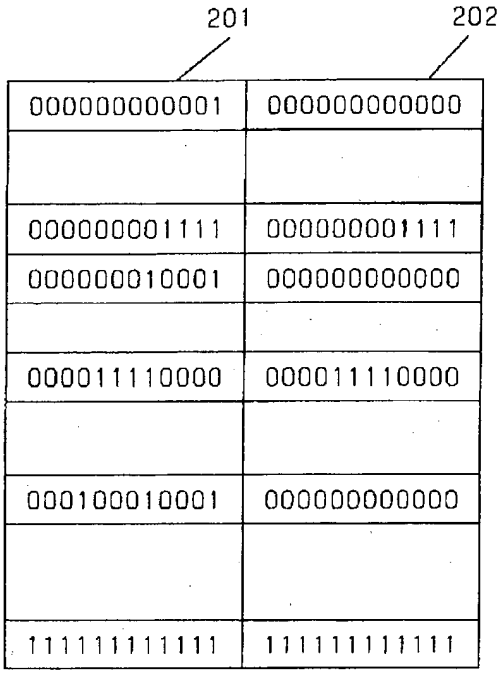
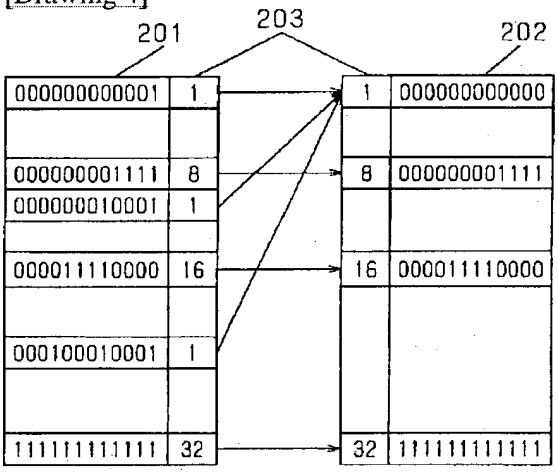
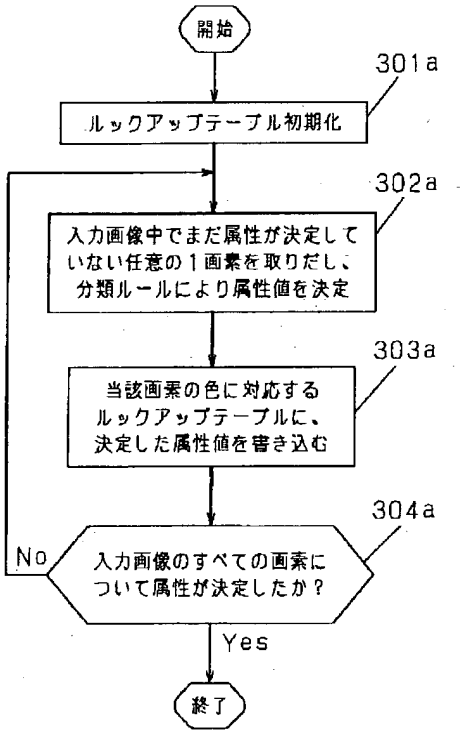


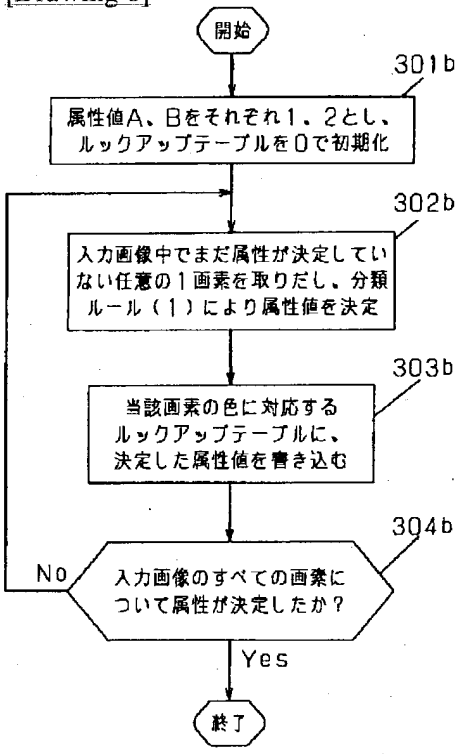
[Drawing 4]



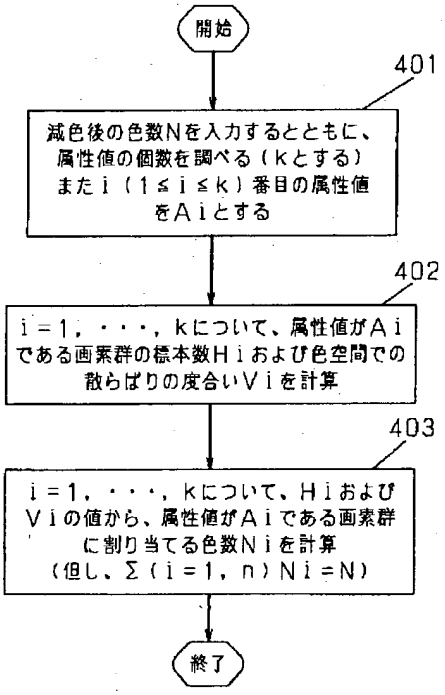
[Drawing 5]



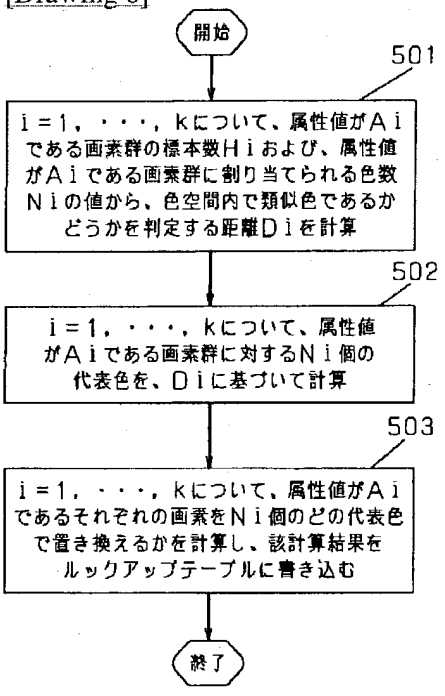
[Drawing 6]



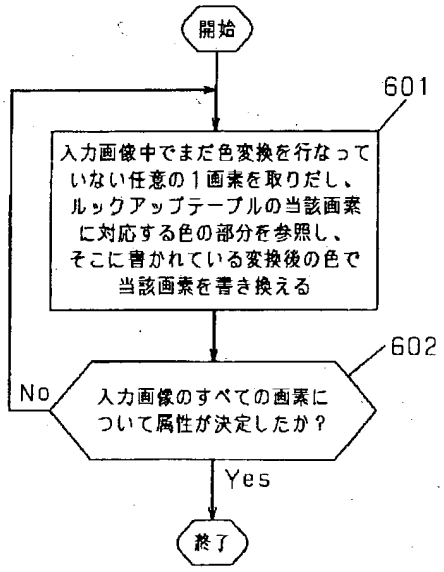
[Drawing 7]



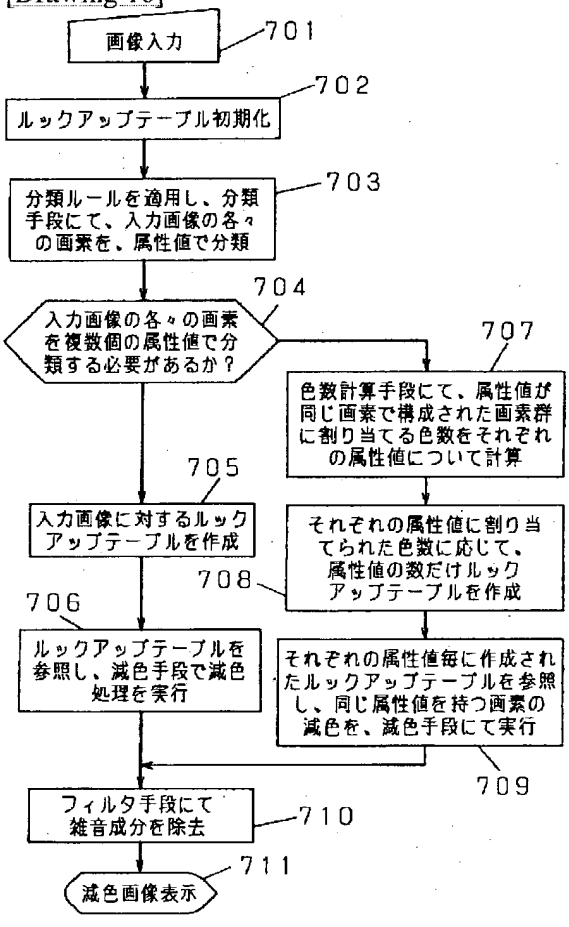
[Drawing 8]



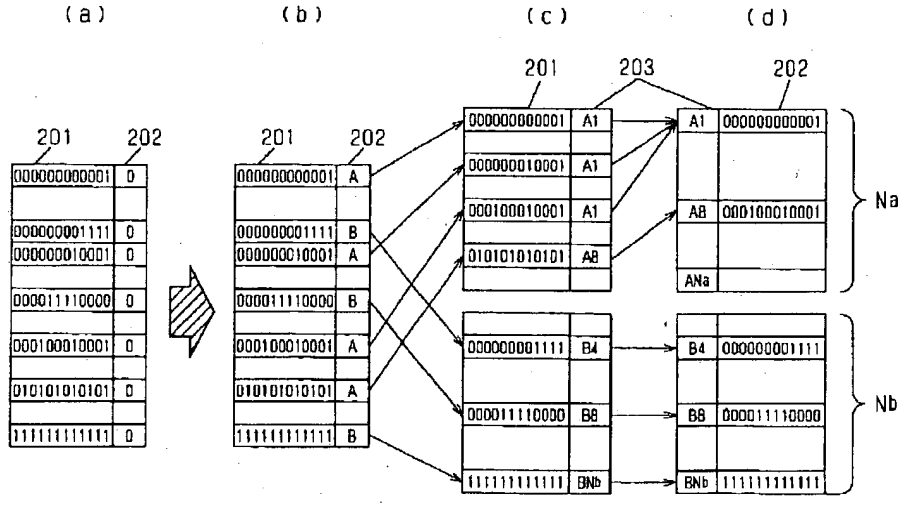
[Drawing 9]



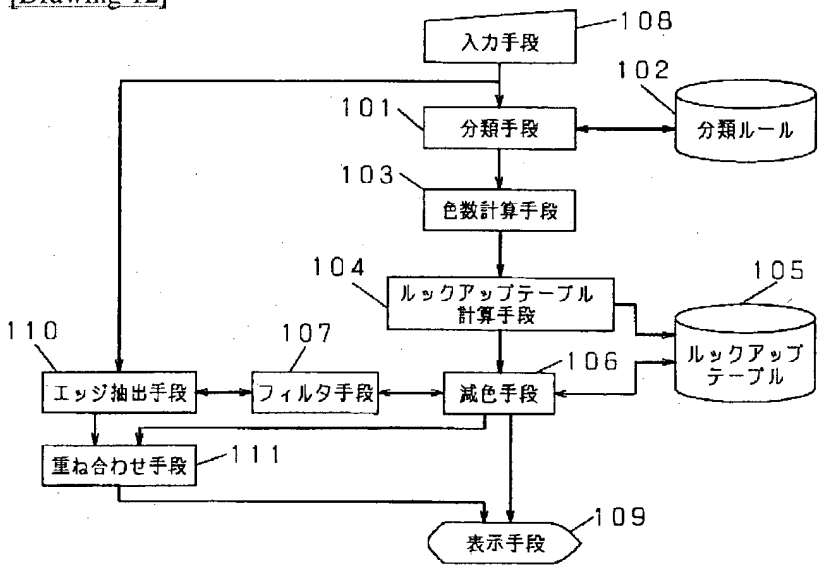
[Drawing 10]



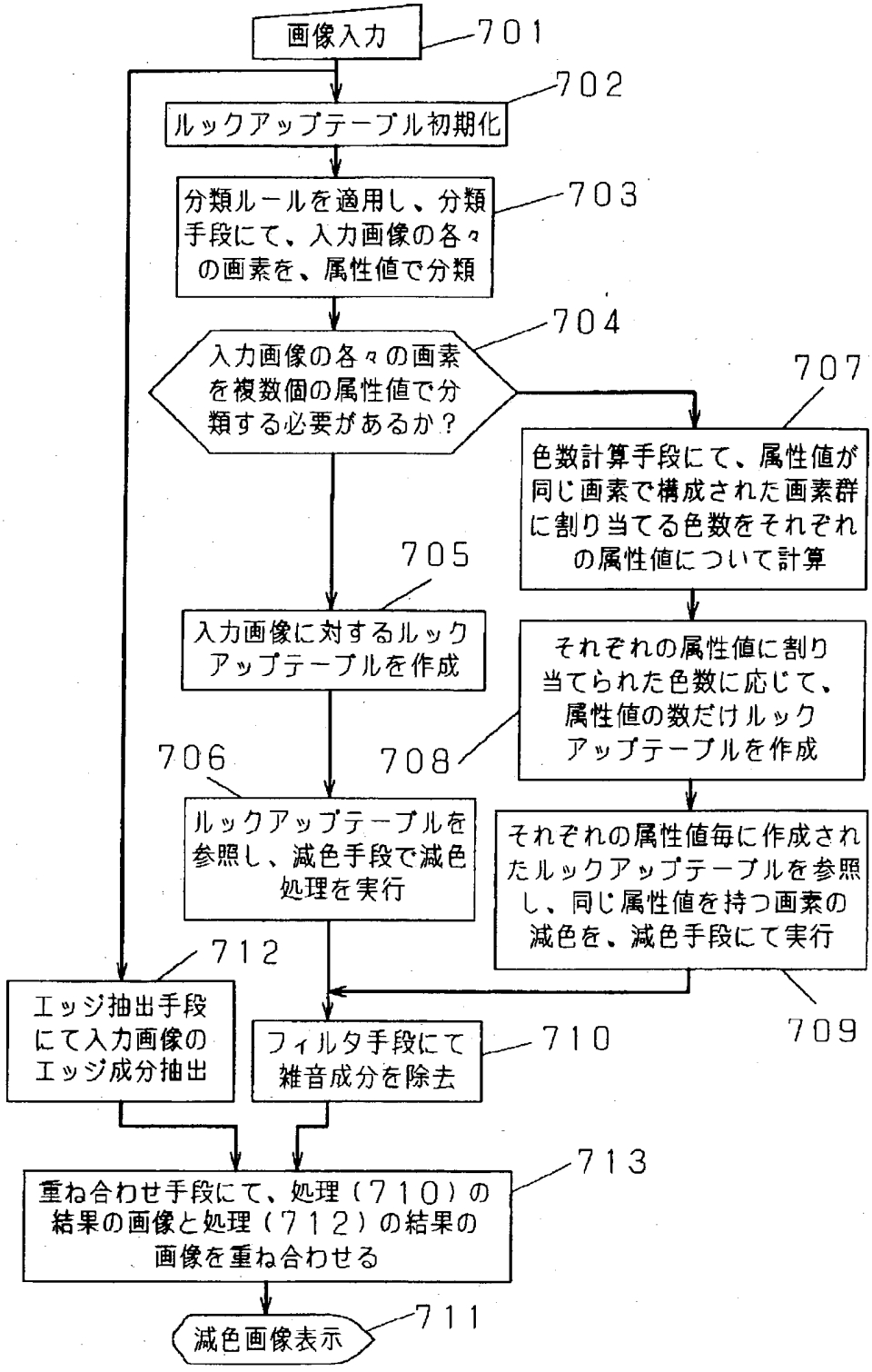
[Drawing 11]



[Drawing 12]



[Drawing 13]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平10－74248

(43)公開日　平成10年(1998)３月17日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ			技術表示箇所
G06T 1/00			G06F 15/66		N	
5/20			G09G 5/06			
G09G 5/06			G06F 15/68	400	A	
H04N 1/60			H04N 1/40		D	
1/46			1/46		Z	

審査請求　未請求　請求項の数10　ＯＬ　（全13頁）

(21)出願番号　特願平8－230020

(22)出願日　平成８年(1996)８月30日

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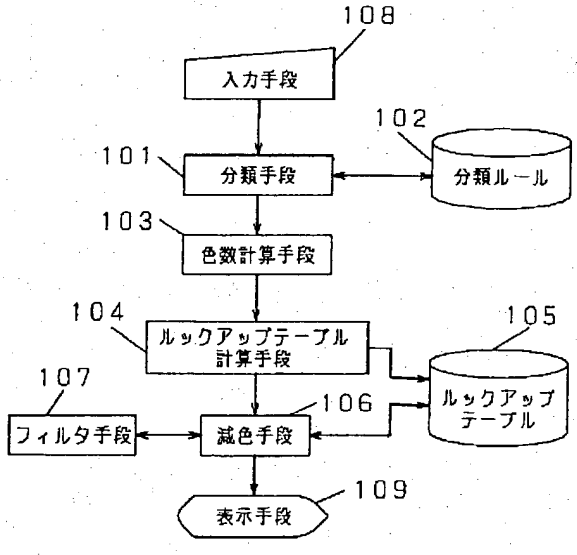
(54)【発明の名称】減色装置および減色方法

(57)【要約】

【課題】　カラー自然画像から、リアルさを除去しつつ元の画像の風合いを残したイラスト風画像を作成する。

【解決手段】　色変換情報を格納するルックアップテーブル105、色の値に応じて入力画像の各画素を分類する分類ルール102、分類ルール102を用いて入力画像の各々の画素を複数個の属性値のいずれかで分類する分類手段101、分類手段101にて入力画像を構成する各々の画素を属性値で分類した結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する色数計算手段103、色変換情報を計算し計算結果をルックアップテーブル105に格納するルックアップテーブル計算手段104、入力画像を構成する各々の画素の色を限定色のいずれかに割り当てる減色手段106を備えた構成を有する。



【特許請求の範囲】

【請求項１】画像を限定色で表現するための色変換情報を格納するルックアップテーブルと、画像を入力し、色変換情報を計算し前記計算結果を前記ルックアップテーブルに格納するルックアップテーブル計算手段と、ルックアップテーブルを参照し、入力画像を構成する各々の画素の色を前記限定色のいずれかに割り当てる減色手段とを備えた減色装置において、分類ルールは色の値に応じて入力画像の各画素を分類するルールであって、前記分類ルールを用いて入力画像の各々の画素を複数個の属性値のいずれかで分類する分類手段とを備えたことを特徴とする減色装置。

【請求項２】分類手段にて入力画像を構成する各々の画素を前記属性値で分類し、前記分類の結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する色数計算手段を備えたことを特徴とする請求項１記載の減色装置。

【請求項３】前記分類ルールは、少なくとも、色を構成する要素のうち彩度、明度の値を入力して、属性値のいずれか一つを出力する高明彩度画素検出ルールを含むことを特徴とする請求項１または２記載の減色装置。

【請求項４】正方形フィルタを用いてフィルタ処理を施すフィルタ手段を備えたことを特徴とする請求項１～３のいずれかに記載の減色装置。

【請求項５】２次元の正方形フィルタ１は、前記フィルタに画像を入力して、頻度のもっとも高い入力値を該フィルタの出力信号とするフィルタであって、減色手段での処理結果に対して前記正方形フィルタ１を用いてフィルタ手段にてフィルタ処理を施すことを特徴とする請求項１～４のいずれかに記載の減色装置。

【請求項６】２次元の正方形フィルタ２は、入力画像に対する前記正方形フィルタの出力信号を前記入力画像のエッジ情報として得るように構成したエッジ抽出フィルタであって、入力画像を少なくとも２以上の階調を持つ白黒濃淡画像に変換し、前記変換結果に対して、前記正方形フィルタ２を用いてフィルタ手段にてフィルタリング処理を施し、該入力画像からエッジ成分を抽出する処理を行なうエッジ抽出手段を備えたことを特徴とする請求項１～４のいずれかに記載の減色装置。

【請求項７】２枚の画像を入力し、該２枚の画像の同じ座標位置の点同士の色を比較した結果に応じて、重ね合わせ後の色を計算し、該２枚の画像のうちのいずれかの一枚の画像の該座標位置の画素に、前記計算した色を上書きする重ね合わせ手段を備えることを特徴とする請求項６記載の減色装置。

【請求項８】ルックアップテーブルは、画像を限定色で表現するための色変換情報を格納し、分類ルールは色の値に応じて入力画像の各画素を分類するルールであって、前記分類ルールを用いて入力画像の各々の画素を複数個の属性値のいずれかで分類する第１のステップと、前記第１のステップでの処理結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する第２のステップと、画像を入力し、色変換情報を計算し前記計算結果を前記ルックアップテーブルに格納する第３のステップと、ルックアップテーブルを参照し、入力画像を構成する各々の画素の色を前記限定色のいずれかに割り当てる第４のステップと、正方形フィルタを用いてフィルタ処理を施す第５のステップとを包含する減色方法。

【請求項９】前記第４のステップでの処理結果に対して請求項５記載の正方形フィルタ１を用いて前記第５のステップにてフィルタリング処理を施すことを特徴とする請求項８記載の減色方法。

【請求項１０】請求項８に記載の減色方法において、さらに、入力画像を少なくとも２以上の階調を持つ白黒濃淡画像に変換し、前記処理結果に対して請求項６に記載の正方形フィルタ５を用いて第５のステップにおいてフィルタリング処理を施し、該入力画像からエッジ成分を抽出する第６のステップと、２枚の画像を入力し、該２枚の画像の同じ座標位置の点同士の色を比較した結果に応じて、重ね合わせ後の色を計算し、該２枚の画像のうちのいずれかの一枚の画像の該座標位置の画素に、前記計算した色を上書きする第７のステップとを包含する減色方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、表示手段や印刷手段などの画像出力手段において出力されるフルカラー画像の色数を意図的に減少させ、リアルさを取り除きつつ原画像の風合いを残した、イラスト風カラー画像を作成する減色装置およびその減色方法に関するものである。

【０００２】

【従来の技術】画像を表示する装置は、一般に、赤（Ｒ）、緑（Ｇ）、青（Ｂ）の組合せによって画素データを表現し、それを表示するものである。特にフルカラー画像と呼ばれる画像を表示する装置では、一般的に一画素当たり赤（Ｒ）、緑（Ｇ）、青（Ｂ）の各々の明度が８ビット（＝２５６）の階調を持つ画像データを蓄えるためのメモリ容量をフレームバッファが持っているため、高精度のフルカラー画像を表示することが可能である。

【０００３】しかしながら、ほとんどのワークステーション、パーソナルコンピュータなどにおいては、フルカラー画像を同時表示できるだけのメモリ容量をフレームバッファが持っていないため、入力のフルカラー画像を表示手段で表示可能な色を用いて疑似的に表示する方法が用いられる。そのためにはフルカラー画像の各々の画素の色を、表示手段で表示可能な色に変換する処理が必要となるが、その処理の方法としては、大きく、

・ディザマトリクスを用いる方法

・色の統計的分布を用いる方法
の２つがある。以下、上記２つの方法を簡単に説明する。

【０００４】1)ディザマトリクスを用いる方法
これは、入力画像の表現できない色の画素を単純に、階調数を減らした場合に生じる偽の輪郭線を目立たなくするために、意図的に雑音を加える方法であり、処理のアルゴリズムによってディザマトリクスを用いる方法を分類すると、以下の２つの方法がある。

【０００５】・当該画素の周辺画素の色などを考慮して当該画素の色を決定する方法
・当該画素の周辺画素の色を考慮せず、あらかじめ用意したディザマトリクスを入力画像に重ね合わせ各画素の色を決定する方法
2)色の統計的分布を用いて減色する方法
入力画像の色分布の統計量を計算し、入力画像を再現するのに最適なＮ色（Ｎ：表示手段で再現可能な色の最大値以下の任意の数）を計算し、ルックアップテーブルを作成する。そして、入力画像の各々の画素について、ルックアップテーブルと、
・同じ色があればその色に、
・同じ色がなければルックアップテーブル内のもっとも似た色に、
変換することによってフルカラー画像データを表示手段で表示可能な色に変換し表示するものである。

【０００６】なお、上記1)の方法は例えば「特開平８－２２２７３号公報」などで、また、上記2)の方法は例えば「特開平５－８９９７２号公報」、「特開平５－２１５２６０号公報」、「”画像解析ハンドブック”、pp.505-516、財団法人東京大学出版会、1991年」などで開示されている。

【０００７】
【発明が解決しようとする課題】本発明の目的とするところは、フルカラー画像を入力し、該入力画像からリアルさを取り除きつつ原画像の風合いを残したイラスト風カラー画像を作成することである。例えばアニメーションやイラストなどにおいて、人物の肌は、色の階調を用いてグラデーションで表現されているより、階調を持たないベタ塗りで表現されている方が、アニメーション、イラストの風あいがより強く出る。従って、フルカラー画像を入力した場合、減色処理によって該フルカラー画像のグラデーション表現を可能な限り単一色で塗りかえられることが望ましい。例えば人物顔のフルカラー画像を入力した場合、肌色の部分は２ないし３色の代表的な肌色で置き換えて表現できるように減色できることが望ましい。しかも異なる色同士の境界は、疑似階調を用いてグラデーション風に表現するのではなく、明確に境界が表現される方がアニメーション、イラストの風あいが強められる。

【０００８】かかる観点で従来の減色処理の有効性を考えると、まず、上記1)のディザマトリクスを用いる方法は、限定色を用いてできるだけ入力のフルカラー画像を的確に再現するための方法であるので、本発明の目的にそぐわないのは明らかである。

【０００９】一方、上記2)の色の統計的分布を用いて減色する方法は、赤（Ｒ）、緑（Ｇ）、青（Ｂ）の３つの明度軸からなるＲＧＢ色空間内で距離を定義し、前記距離の近い色同士を一つの代表となる色にまとめることにより色数を減らしていく仕組みである。すなわち、従来の方法では、表示色の数（仮にここではＭとする）を指定すると、入力のフルカラー画像全体をスキャンして、Ｍ色に塗り分けるためのＲＧＢ空間内での最適な距離を計算し、
・Ｍ個の代表色の計算
・前記距離に応じた入力画像の各画素のＭ個の代表色への変換
を行なうもので、入力のフルカラー画像全体をスキャンして代表のＭ色を決めるため、Ｍの値を小さく設定すれば前記距離は大きくなり、従って、似た色が連続的に変化するグラデーション部分はある程度単一色もしくは２、３の複数の色で置き換えることが可能である。

【００１０】ところで、例えば全体的にくすんでいて、ほんの少しだけ彩やかな部分が存在する画像を考える。このような画像では、該彩やかな部分は際だって人の目に印象的に写るものであるが、従来の方法では、入力画像中で使用頻度の少ない色は、前記代表色のいずれかに吸収されることになるため、上記の彩やかな部分の色は、計算済みの代表色のどれかに置き換えられてしまうことになり、処理の結果得られた減色画像から受ける印象は、入力画像から受ける印象とは異なるものになる可能性が高い。

【００１１】従って解決すべき課題としては、ほんの少しだけ彩やかな部分が存在ずる画像を入力しても、その彩やかな部分を残しつつ画像の減色処理を行なうことが可能な装置およびその方法を提供することである。

【００１２】
【課題を解決するための手段】かかる課題を解決するために、本発明による減色装置は、画像を限定色で表現するための色変換情報を格納するルックアップテーブルと、色の値に応じて入力画像の各画素を分類する分類ルールと、前記分類ルールを用いて入力画像の各々の画素を複数個の属性値のいずれかで分類する分類手段と、分類手段にて入力画像を構成する各々の画素を前記属性値で分類し、前記分類の結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する色数計算手段と、画像を入力し、色変換情報を計算し前記計算結果を前記ルックアップテーブルに格納するルックアップテーブル計算手段と、ルックアップテーブルを参照し、入力画像を構成する各々の画素の色を前記限定色のいずれかに割り当てる

減色手段と、を主たる構成要素として具備することを特徴とする。

【００１３】また本発明による減色方法は、前記分類ルールを用いて入力画像の各々の画素を複数個の属性値のいずれかで分類する第１のステップと、前記第１のステップでの処理結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する第２のステップと、画像を入力し、色変換情報を計算し前記計算結果を前記ルックアップテーブルに格納する第３のステップと、ルックアップテーブルを参照し、入力画像を構成する各々の画素の色を前記限定色のいずれかに割り当てる第４のステップと、正方形フィルタを用いてフィルタ処理を施す第５のステップと、を包含することを特徴とする。

【００１４】本発明では、まず、分類手段によって、分類ルールを参照しつつ入力画像の各々の画素を複数個の属性値のいずれかで分類し、続いて色数計算手段にて、分類結果を参照して、各々の属性値に対してそれぞれに、同じ属性値を持つ画素群に割り当てる色数を計算する。

【００１５】ルックアップテーブル計算手段では、前記色数計算手段の処理結果を参照して、各々の属性値について、それぞれに対応したルックアップテーブルを作成し、最後に減色手段にて、前記ルックアップテーブルを参照して入力画像の各々の画素の色変換を行なって所望の減色処理画像を得る。

【００１６】

【発明の実施の形態】以下、本発明の一実施例を図面を用いて説明する。図１は、本発明の請求項１に記載の減色装置の構成を示したブロック図である。

【００１７】本発明による減色装置は、主たる構成要素として、画像を限定色で表現するための色変換情報を格納するルックアップテーブル(105)と、色の値に応じて入力画像の各画素を分類する分類ルール(102)と、分類ルール(102)を用いて入力画像の各々の画素を複数個の属性値のいずれかで分類する分類手段(101)と、分類手段(101)にて入力画像を構成する各々の画素を前記属性値で分類し、前記分類の結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する色数計算手段(103)と、画像を入力し、色変換情報を計算し前記計算結果をルックアップテーブル(105)に格納するルックアップテーブル計算手段(104)と、ルックアップテーブル(105)を参照し、入力画像を構成する各々の画素の色を前記限定色のいずれかに割り当てる減色手段(106)とを備えることを特徴とし、さらに、画像を入力する入力手段(108)と、正方形フィルタを用いてフィルタ処理を施すフィルタ手段(107)と、画像を表示する表示手段(109)とからなる構成を有する。

【００１８】以下、本発明を構成する各構成要素について説明する。図２～図４は、本発明における処理全般において必要とするルックアップテーブル(105)の構成例を示した概念図である。まず、図２に示すルックアップテーブル(105)は、赤（Ｒ）、緑（Ｇ）、青（Ｂ）の各々の明度が８ビット（＝２５６）の階調を持つ場合の具体例である。この例では、ＲＧＢをこの順に上位から８ビットずつ埋めて合計３バイトで表される数値をルックアップテーブル(105)のテーブル番号（201、配列でいう要素番号に対応する）とし、その配列要素(202)には、実際に置き換えるべき色のデータが格納されるという構成をとる。

【００１９】例えば図２の例では、(Ｒ,Ｇ,Ｂ)の値が(0x01,0x01,0x01)ならば、これをまとめて３バイトで表現すると0x010101になり、さらに0x010101を十進法に変換すると、65793番目の配列要素のデータということになり、そこに格納されているデータが0x000000であることから、前記(0x01,0x01,0x01)のデータがあれば、このデータは(0x00,0x00,0x00)で置き換えるということが、図２のルックアップテーブル(105)から読みとれる。

【００２０】しかしながら、前述のように、赤（Ｒ）、緑（Ｇ）、青（Ｂ）の各々の明度が８ビット（＝２５６）の階調を持つルックアップテーブル(105)を作成するとなると、該ルックアップテーブル(105)を格納するメモリ容量が多大になることが問題となる。例えば、図２の例では、色変換後のデータを格納するデータが、１色につき３バイト必要であり、また、このデータ配列サイズは色数分、すなわち16777216個になるため、メモリ容量や処理速度などの面で実装には適しない。

【００２１】そこで実際には、例えば赤（Ｒ）、緑（Ｇ）、青（Ｂ）の各々の明度を４ないし５ビットの階調まで落したルックアップテーブル(105)などが用いられる。図３は赤（Ｒ）、緑（Ｇ）、青（Ｂ）の各々の明度が４ビット場合のルックアップテーブル(105)の例であり、この場合、ルックアップテーブル(105)のサイズは4096個で済む。

【００２２】また、図４は減色後の色数が２５６色（＝１バイト）以内の場合、さらに必要なメモリ容量を少なくすることのできるように構成したルックアップテーブル(105)である。この例では、従来のルックアップテーブル(105)においての減色後の色を書き込む部分に、直接その色を書き込むのではなく、その色データが実際に書き込んである対応表（特にここではカラーパレットと呼ぶ）の行番号(203)にしてある。こうすれば、ルックアップテーブル(105)の減色後の色を書き込む場所のサイズは１バイトですむ。別にカラーパレットを用意する必要はあるが、必要なメモリの合計を考えれば、カラーパレットを別に作成するほうが少ないメモリ容量で済むことは明らかである。

【００２３】本発明による分類手段(101)は、本発明による分類ルール(102)を用いて入力画像の各々の画素を

複数個の属性値のいずれかで分類するものであり、該分類ルール(102)とは、ある画素について該画素の色の値に応じて入力画像の各画素を分類するルールであって、例えば以下の例に示すようなものである。ただし、ここでは、彩度をs、明度をvで表し、sとvはいずれも０～２５５の範囲の値をとるものとする。

【００２４】なお、分類手段(101)における処理は、本発明の請求項８に記載の減色方法における第１のステップの処理に対応するものである。

【００２５】分類ルールの例：「ある画素について、当該画素のs,vの値を計算し、（sが１２８以上でかつvの値が１４４以上）または、（vの値が２２４以上）であれば、当該画素の属性値の値をA、そうでなければ属性値の値をBとする」。

【００２６】なお、上記の例で用いた分類ルール(102)は、本発明の請求項３に記載の高明彩度画素検出ルールの一実施例としても使用可能である。以下では上記の例を分類ルール（１）と呼ぶ。

【００２７】続いて分類手段(101)での処理の流れを図５に従って説明する。図５は本発明による分類手段(101)での処理の流れを示すフローチャートである。

【００２８】(301a)属性値として使用する値以外の値でルックアップテーブル(105)を初期化する。

【００２９】(302a)入力画像中でまだ属性値が決定していない任意の１画素を取りだし、分類ルール(102)により当該画素の属性値を決定する。

【００３０】(303a)当該画素の色に対応するルックアップテーブル(105)に、決定した属性値を書き込む。

【００３１】(304a)入力画像のすべての画素について、上記(302a)～(303a)の処理が終了したならば、分類手段(101)での処理を終了する。また未終了であるならば、(302a)に戻り(302a)～(303a)の処理を繰り返す。

【００３２】なお、図６は、図５において分類ルール（１）を適用した場合の具体的な処理フローの例である。処理の流れの内容は図５と同じであるので説明は省略する。

【００３３】本発明による色数計算手段(103)は、入力画像を構成する各々の画素が分類手段(101)にて分類された結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する。図７は本発明による色数計算手段(103)における処理の流れの例をフローチャートの形式で示したもので、図７に従って色数計算手段(103)での処理例を説明する。なお、色数計算手段(103)における処理は、本発明の請求項８に記載の減色方法における第２のステップの処理に対応するものである。

【００３４】(401)減色後の色数Ｎを入力する。また、ルックアップテーブル(105)を参照することにより、分類手段(101)にて分類された属性値の個数を調べる。ここでは説明の都合上、前記個数はｋ個とし、また、ｉ(１≦ｉ≦ｋ)番目の属性値をＡｉとする。

【００３５】(402)ｉ＝１、…、ｋについて、属性値がＡｉである画素群の標本数Ｈｉ、および属性値がＡｉである画素群のちらばりの度合いＶｉを計算する。

【００３６】ここで、前記Ｖｉの計算方法には色々考えられるが、例えば、画素を赤（Ｒ）、緑（Ｇ）、青（Ｂ）の色の構成要素に分解し、赤（Ｒ）、緑（Ｇ）、青（Ｂ）のそれぞれでのパラメータ空間で分散を計算したものの合計値でもってＶｉの値とするなど、色空間での画素群の散らばりを反映させられるものであれば、Ｖｉの計算方法はどのようなものであってもよい。

【００３７】(403)ｉ＝１、…、ｋについて、Ｈｉの値およびＶｉの値から、属性値がＡｉである画素群に割り当てる色数Ｎｉを計算する。

【００３８】ここで、Ｎｉの計算方法には色々考えられるが、基本方針として、

・頻度Ｈｉが大きい場合にはＮｉの値を大きく、Ｈｉが小さい場合にはＮｉの値を小さくする。

【００３９】・散らばりの度合いＶｉが大きい場合にはＮｉの値を大きく、Ｖｉが小さい場合にはＮｉの値を小さくする。

【００４０】とすれば色数の妥当な割当ができると考えられる。上記方針に基づいて例えば次の式（１）、

Ｎｉ＝Ｓｑｒｔ(Ｈｉ)×Ｖｉ　式（１）

(但しSqrt(x)はxの平方根を返す関数)でＮｉを計算し、続いて、

Σ（ｉ＝１，…，ｋ）Ｎｉ＝Ｎ

満たすようにＮｉを正規化し目的のＮｉを得るなどの方法が有効であると思われる。

【００４１】上記では、属性値がＡｉである画素群の標本数Ｈｉ、及び属性値がＡｉである画素群のちらばりの度合いＶｉに基づいて色数Ｎｉを計算する方法を示したが、例えば処理速度の遅い装置でできるだけ処理コストを小さくしたい場合などは、もっと簡単に、ｉ＝１、…、ｋについて、属性値がＡｉである画素群の標本数Ｈｉのみを観測し、その平方根の比でＮｉの値を決めるなどの方法でもよい。

【００４２】すなわち、例えば次の式（２）、

Ｎｉ＝Ｓｑｒｔ(Ｈｉ)　式（２）

(但しSqrt(x)はxの平方根を返す関数)でＮｉを計算し、続いて、

Σ（ｉ＝１，…，ｋ）Ｎｉ＝Ｎ

を満たすようにＮｉを正規化し目的のＮｉを得るなどの方法が有効であると思われる。

【００４３】なお、Ｎｉの計算においては、上記の式（１）または式（２）のどちらを用いるとしてもＨｉの値がＮｉに影響を及ぼすが、Ｈｉが十分小さい場合、Ｎｉに１以上の値を与えるのは無意味となる。その場合、ｉ番目の属性値は何らかの手段でそれ以外のいずれかの属性値に置き換えるのがよい。例えば、ある分類ルール

(102)によって２つの属性に分けるべき状況で、どちらか１つの属性に分類された画素の総数が、他方の属性に分類された画素の総数の、例えば０．３％に満たないという結果になった場合、すべての画素を同じ属性値にしてしまうなどが上記置き換えの一例にあたるわけで、分類結果に応じて該例のような追加処理が必要な場合は、追加処理が必要な条件と、前記追加処理の内容を、合わせて分類ルール(102)に記述しておけばよい（下記の例参照）。

【００４４】分類ルール（１）の処理を追加した例：「ある画素について、当該画素のs,vの値を計算し、（sが１２８以上でかつvの値が１４４以上）または、（vの値が２２４以上）であれば、当該画素の属性値の値をＡ、そうでなければ属性値の値をＢとする」。

【００４５】また、分類処理後、必要に応じて以下の２処理を実行する

・属性値がＡの画素の占める割合がが全体の０．３％以下なら、属性値がＡの画素の属性値をすべてＢに変更する。

【００４６】・属性値がＢの画素の占める割合がが全体の０．３％以下なら、属性値がＢの画素の属性値をすべてＡに変更する。

【００４７】本発明によるルックアップテーブル計算手段(104)は、属性値が同じ画素で構成される画素群に割り当てる色数に基づいて、属性値が同じ画素で構成される画素群の代表色を計算し、前記計算結果をルックアップテーブル(105)に格納する。

【００４８】図８は本発明によるルックアップテーブル計算手段(104)における処理の流れの例を示すフローチャートで、図８に従ってルックアップテーブル計算手段(104)での処理例を説明する。尚、ルックアップテーブル計算手段(104)における処理は、本発明の請求項８に記載の減色方法における第３のステップの処理に対応するものである。

【００４９】(501)ｉ＝１、…、ｋについて、属性値がＡｉである画素群の標本数Ｈｉの値および、属性値がＡｉである画素群に割り当てられる色数Ｎｉから、属性値がＡｉである画素群を対象として色空間内で類似した色であるかどうかを判断する距離Ｄｉを計算する。

【００５０】Ｄｉの計算方法についてはさまざまな方法が開示されている。例えば前出の文献「”画像解析ハンドブック”」のpp.513-514に開示の立方最密配置による方法で定義されている距離は、本方法に適した距離定義の一つであると思われる。

【００５１】(502)ｉ＝１、…、ｋについて、属性値がＡｉである画素群に対するＮｉ個の代表色を、前記距離Ｄｉに基づいて計算する。前出の文献に開示の立法最密配置による方法では、該代表色を選定するアルゴリズムについても開示されているが、本処理における代表色の選定に前記アルゴリズムを適用することが可能である。なお、前記アルゴリズムでは、決められた計算を繰り返すことよってより適切な代表色を決定する方法が開示されているが、処理速度の遅い装置でできるだけ処理コストを小さくしたい場合などは、前記決められた計算を一度行なうだけでもある程度の質を保った結果を得ることが可能である。

【００５２】(503)ｉ＝１、…、ｋについて、属性値がＡｉであるそれぞれの画素Ｎｉ個のどの代表色で置き換えるかを、色空間での距離に基づいて計算し、結果をルックアップテーブル(105)に書き込み、ルックアップテーブル計算手段(104)での処理を終了する。

【００５３】本発明による減色手段(106)は、ルックアップテーブル(105)を参照し、入力画像を構成する各々の画素の色を前記限定色のいずれかに割り当てる処理を行なう。図９は本発明による減色手段(106)での処理の流れをフローチャートで簡単に示した例で、図９に従って減色手段(106)での処理の流れを簡単に説明する。なお、減色手段(106)における処理は、本発明の請求項８に記載の減色方法における第４のステップの処理に対応するものである。

【００５４】(601)入力画像中でまだ色変換を行なっていない任意の１画素を取りだし、ルックアップテーブル(105)の当該画素の当該画素に対応する色の部分を参照し、そこに書かれている変換後の色で当該画素の色を書き換える。

【００５５】(602)入力画像のすべての画素について、上記(601)の処理が終了したならば、減色手段(106)での処理を終了する。また未終了であるならば、(601)の処理を繰り返す。

【００５６】次に、本発明による減色装置および減色方法での減色処理の全体の流れを図１０のフローチャートに従って説明する。また図１１は処理が進んでいくにつれてルックアップテーブル(105)の内容が書き変わっていく様子を示したものである。なお本例は、入力画像の各画素の色データの赤（Ｒ）、緑（Ｇ）、青（Ｂ）各々の明度が４ビット（＝１６）の階調を持ち、分類ルール(102)は前述の分類ルール（１）を用いた場合についてである。

【００５７】(701)入力手段(108)にて画像を入力し、ルックアップテーブル(105)を初期化する。図１１(a)はルックアップテーブル(105)が初期化された状態を示したものである。

【００５８】(702)分類手段(101)によって、分類ルール(102)を参照しつつ入力画像の各々の画素を複数個の属性値のいずれかで分類し、その結果をルックアップテーブル(105)に上書きする（図１１(b)）。なお本例は分類ルール(102)の例として前出の分類ルール（１）を用いた場合である。

【００５９】(703)色数計算手段(103)にて、ルックアップテーブル(105)を参照することにより、分類手段(101)

にて分類された属性値の個数が複数個かどうかを調べる。この個数をｋとする。もしｋ＝１なら、以下の処理(704)～(705)を、ｋ＞１ならば以下の処理(706)～(708)を実行する。前記分類ルール（１）では、画素をＡとＢの２種類の属性値に分類するルールであるのでｋ＝２となる。

【００６０】尚、以下の処理(705)においてのルックアップテーブル(105)の構成方法については公知の技術であるため、以下では、ルックアップテーブル(105)が再構成されその内容が書き換えられていく様子は、(707)の処理においてのみ図１１(c,d)を用いた説明を行なう。

【００６１】(704)ルックアップテーブル計算手段(104)によって、あらかじめ指定されている減色処理後の色数分の代表色を計算し、ルックアップテーブル(105)を完成させる。ｋ＝１の場合、ルックアップテーブル(105)は図４に描かれたように、通常の形式のルックアップテーブル(105)となる。

【００６２】(705)減色手段(106)にて、ルックアップテーブル(105)を参照し、入力画像を構成する各々の画素の色を前記限定色の対応する色で書き換える。

【００６３】(706)色数計算手段(103)にて、入力画像を構成する各々の画素が分類手段(101)にて分類された結果に基づいて、属性値が同じ画素で構成される画素群に割り当てる色数を、それぞれの属性値について計算する。ここでは仮にＡに割り当てられた色数をＮａ、Ｂに割り当てられた色数をＮｂとする。

【００６４】(707)ルックアップテーブル計算手段(104)によって、それぞれの属性値に対応したルックアップテーブル(105)を作成し、同時に減色後の色数分の代表色を計算し、ルックアップテーブル(105)を完成させる。図１１(c)の例では、属性値ＡおよびＢに対応した２つのルックアップテーブル(105)を作成する。また、サイズ（配列の大きさ）がＮａ、Ｎｂのカラーパレット（図１１(d)）も同時に作成する。そして、属性値ＡについてはＮａ分の、属性値ＢについてはＮｂ分の代表色を計算し、それぞれに対応したルックアップテーブル(105)を完成させる。

【００６５】(708)減色手段(106)にて、入力画像を構成する各々の画素の色を、前記画素の属性値ＡおよびＢに対応したルックアップテーブル(105)を参照し、前記限定色の対応する色で書き換える。

【００６６】(709)必要であれば減色処理後の画像に雑音除去などのフィルタ処理を施す。

(710)表示手段(109)にて減色画像を表示し、減色処理を終了する。

【００６７】なお、図１２は、本発明の請求項７に記載の減色装置の構成例を示したブロック図である。本発明の請求項７に記載の減色装置では、図１２で示してあるがごとく、本発明の請求項１に記載の減色装置（図１）にさらに、フィルタ手段(107)を用いて入力画像のエッジ成分を抽出するエッジ抽出手段(110)、画素の明度値を比較して２枚の画像を合成する重ね合わせ手段(111)を加えた構成にすることにより、減色した画像にエッジ画像を重ね合わせることができる。この場合、重ね合わせ手段(111)において、画像を重ね合わせた後の色の計算方法としては、入力した２枚の画像の同じ座標位置の点同士の明度を比較し、明度の低いほうの画素の色を、重ね合わせ後の画素の色とするなどの方法を用いれば良い。該重ね合わせ処理により、入力画像に対して、アニメーション風の効果が施された画像を自動で作成することが可能となる。

【００６８】なお、フィルタ手段(107)における処理は、本発明の請求項８に記載の減色方法における第５のステップの処理に、また、前記重ね合わせ手段(111)における処理は、本発明の請求項１０に記載の減色方法における第７のステップの処理にそれぞれ対応するものである。

【００６９】図１３は本発明の請求項７に記載の減色装置および請求項１０に記載の減色方法における処理の流れをフローチャートの形式で示したものである。全体の処理は、減色の処理（(701)～(710)）とエッジ抽出の処理(711)を並行して実行した後（どちらの処理が先でもよい）、最後に、(701)減色の処理結果の画像とエッジ抽出処理結果の画像を重ね合わせて終了する。なお、エッジ抽出手段(110)の構成方法および、その際に使用する正方形フィルタの構成方法については、特願平８－８１２６８号にて詳述しているので、ここでは説明は省略する。また、図１３における処理(701)～(710)は、図１０における処理と同じであるので説明は省略する。またエッジ抽出手段(110)における処理は、本発明の請求項１０に記載の減色方法における第６のステップの処理に対応するものである。

【００７０】

【発明の効果】本発明では、用途に応じた分類ルールを用意し、分類手段にて該分類ルールを用いて入力画像の色分布を分析分類することにより、例えば全体的にくすんでいて、ほんの少しだけ彩やかな部分が存在する画像については、該彩やかな部分の存在がどの程度あるか確認でき、前記分類手段の処理結果によって該彩やかな部分とそれ以外の部分とに割り当てる適切な色数を色数計算手段によって計算する処理を新たに組み込んでいる。

【００７１】従来の減色処理においては、全体に対して統計的に頻度の小さいデータが頻度の大きいデータに吸収されるため、該頻度の小さいデータが減色処理によって失われてしまうという問題があったが、この分類ルール、分類手段および色数計算手段の導入によって、頻度が小さくても必要である部分を残したままの減色処理が可能となった。例えば上記画像の例では、ほんの少しだけ彩やかな部分とそれ以外の部分とで独立して減色処理

を行なうことを実現し、その結果として、減色処理後も彩やかな部分を残すことができる。

【図面の簡単な説明】

【図１】本発明の請求項１に記載の減色装置の一実施の形態の構成を示したブロック図

【図２】従来のルックアップテーブルの構成例を示した概念図

【図３】従来のルックアップテーブルの構成例を示した概念図

【図４】従来のルックアップテーブルの構成例を示した概念図

【図５】本発明による分類手段での処理の流れを示すフローチャート

【図６】本発明による分類手段での処理の流れを分類ルールの例に基づいて示したフローチャート

【図７】本発明による色数計算手段における処理の流れの例を示すフローチャート

【図８】本発明によるルックアップテーブル計算手段における処理の流れの例を示すフローチャート

【図９】本発明による減色手段での処理の流れを示すフローチャート

【図１０】本発明による減色装置および減色方法での減色処理の全体の流れを示すフローチャート

【図１１】本発明によるルックアップテーブルの構成例を示した概念図

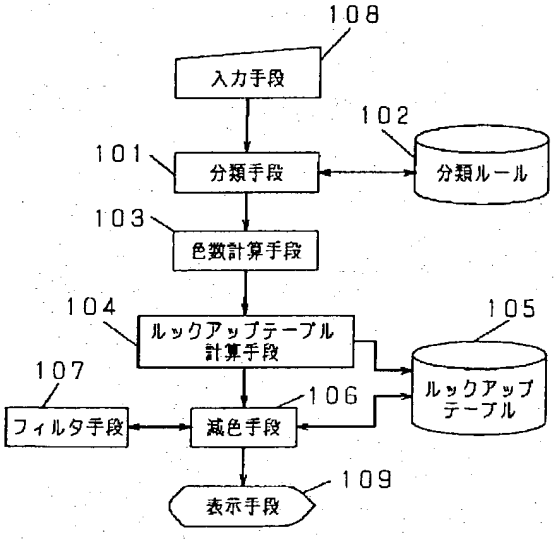
【図１２】本発明の請求項７に記載の減色装置の構成例を示したブロック図

【図１３】本発明の請求項７に記載の減色装置および請求項１０に記載の減色方法における処理の流れを示すフローチャート

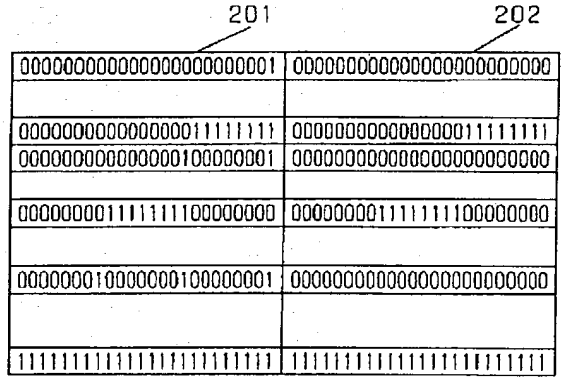
【符号の説明】

１０１　分類手段
１０２　分類ルール
１０３　色数計算手段
１０４　ルックアップテーブル計算手段
１０５　ルックアップテーブル
１０６　減色手段
１０７　フィルタ手段
１０８　入力手段
１０９　表示手段
１１０　エッジ抽出手段
１１１　重ね合わせ手段

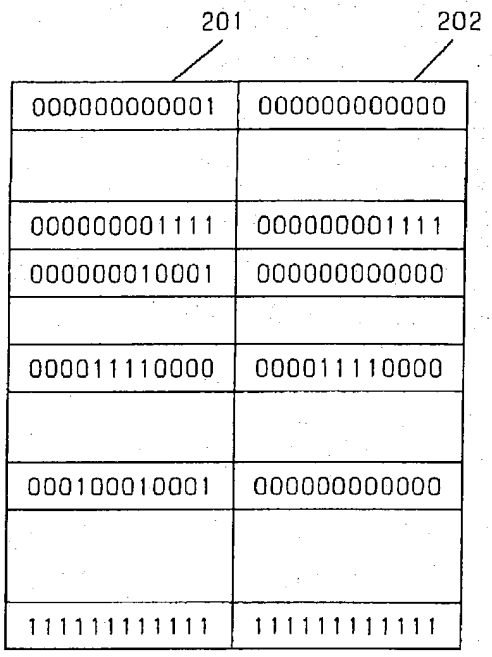
【図１】



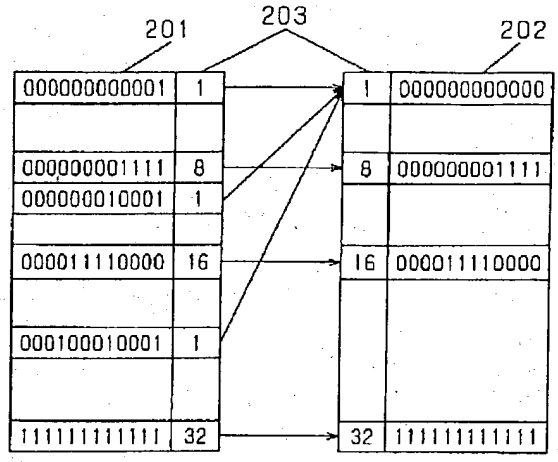
【図２】



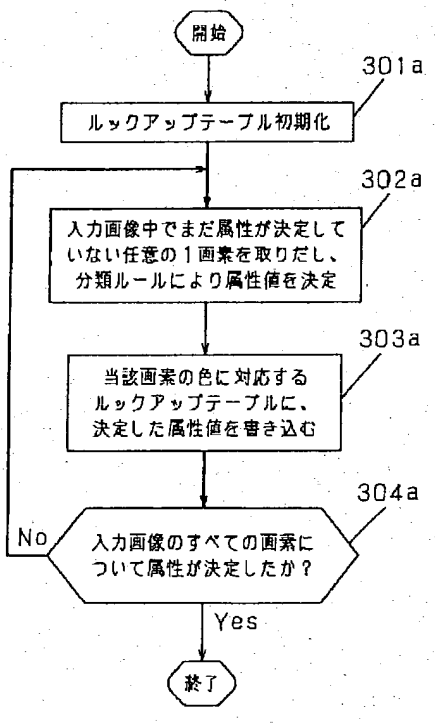
【図３】


201
202
000000000001
000000000000
000000001111
000000001111
000000010001
000000000000
000011110000
000011110000
000100010001
000000000000
111111111111
111111111111

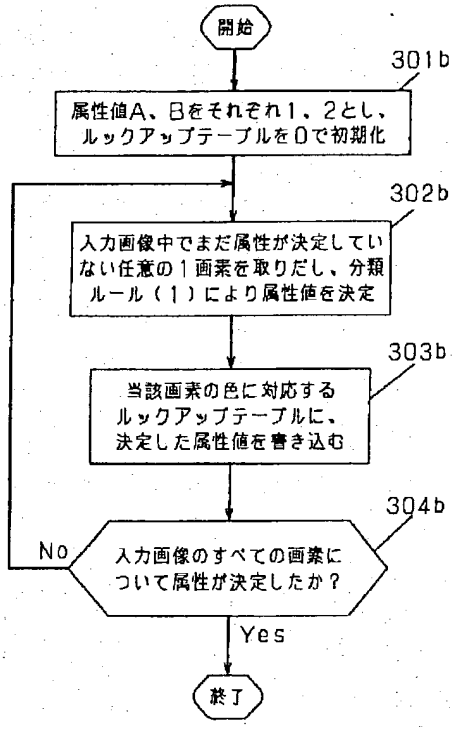
【図４】


201
203
202
000000000001
1
1
000000000000
000000001111
8
8
000000001111
000000010001
1
000011110000
16
16
000011110000
000100010001
1
111111111111
32
32
111111111111

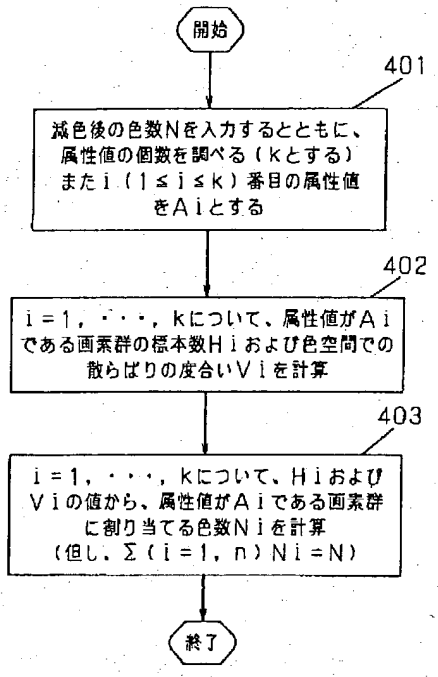
【図５】


開始
301a
ルックアップテーブル初期化
302a
入力画像中でまだ属性が決定していない任意の１画素を取りだし、分類ルールにより属性値を決定
303a
当該画素の色に対応するルックアップテーブルに、決定した属性値を書き込む
304a
No
入力画像のすべての画素について属性が決定したか？
Yes
終了

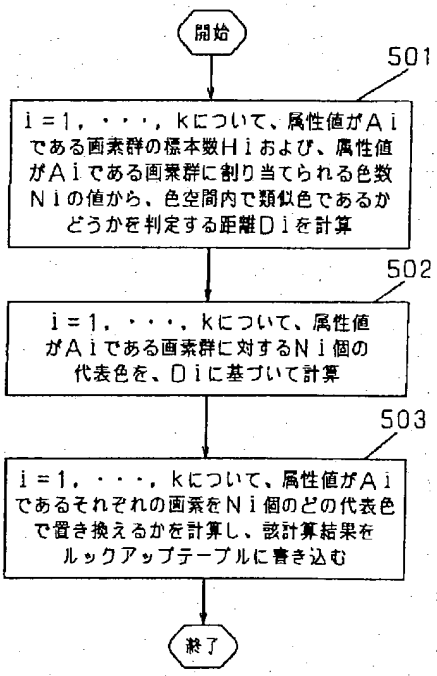
【図６】


開始
301b
属性値A、Bをそれぞれ１、２とし、ルックアップテーブルを０で初期化
302b
入力画像中でまだ属性が決定していない任意の１画素を取りだし、分類ルール（１）により属性値を決定
303b
当該画素の色に対応するルックアップテーブルに、決定した属性値を書き込む
304b
No
入力画像のすべての画素について属性が決定したか？
Yes
終了

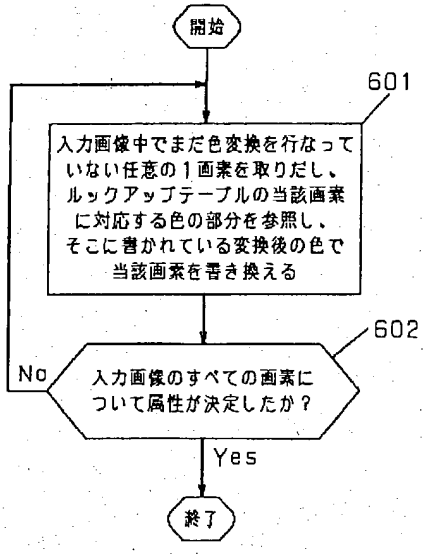
【図７】


開始
401
減色後の色数Nを入力するとともに、属性値の個数を調べる（kとする）またi（1≦i≦k）番目の属性値をAiとする
402
i＝1，・・・，kについて、属性値がAiである画素群の標本数Hiおよび色空間での散らばりの度合いViを計算
403
i＝1，・・・，kについて、HiおよびViの値から、属性値がAiである画素群に割り当てる色数Niを計算（但し、Σ（i＝1，n）Ni＝N）
終了

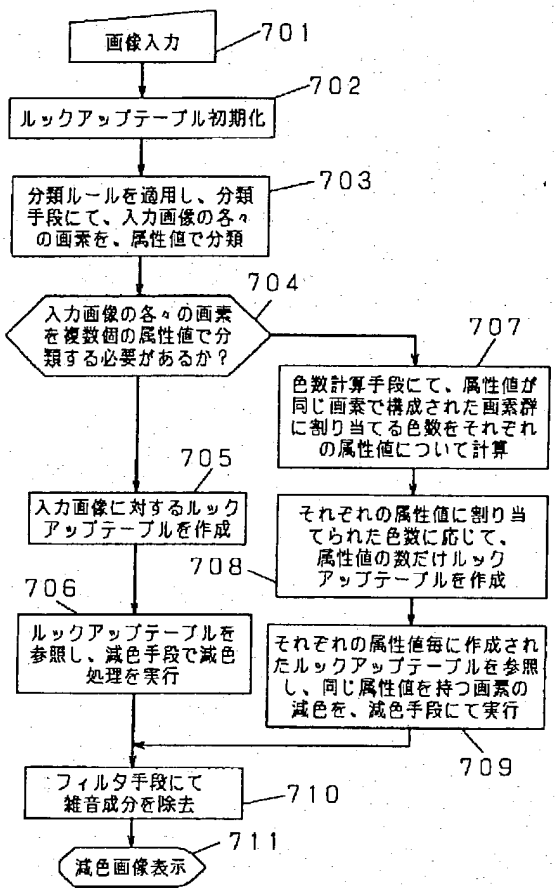
【図８】


開始
501
i＝1，・・・，kについて、属性値がAiである画素群の標本数Hiおよび、属性値がAiである画素群に割り当てられる色数Niの値から、色空間内で類似色であるかどうかを判定する距離Diを計算
502
i＝1，・・・，kについて、属性値がAiである画素群に対するNi個の代表色を、Diに基づいて計算
503
i＝1，・・・，kについて、属性値がAiであるそれぞれの画素をNi個のどの代表色で置き換えるかを計算し、該計算結果をルックアップテーブルに書き込む
終了

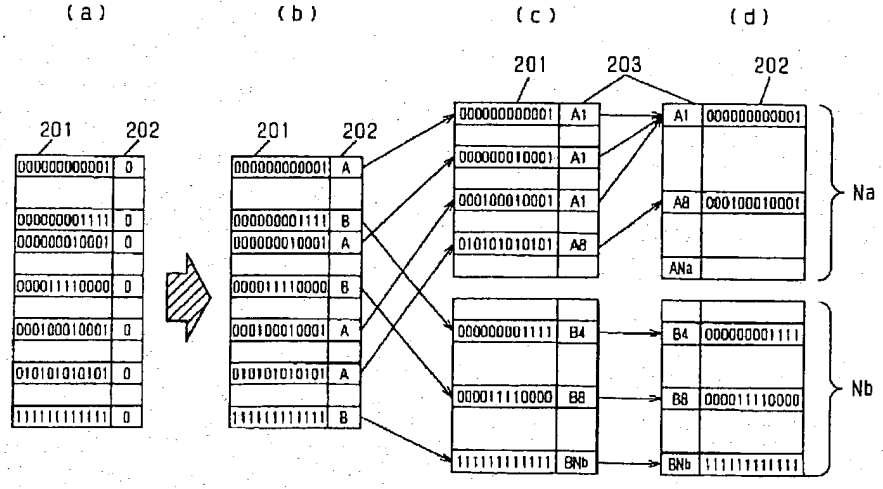
【図９】


開始
601
入力画像中でまだ色変換を行なっていない任意の１画素を取りだし、ルックアップテーブルの当該画素に対応する色の部分を参照し、そこに書かれている変換後の色で当該画素を書き換える
602
No
入力画像のすべての画素について属性が決定したか？
Yes
終了

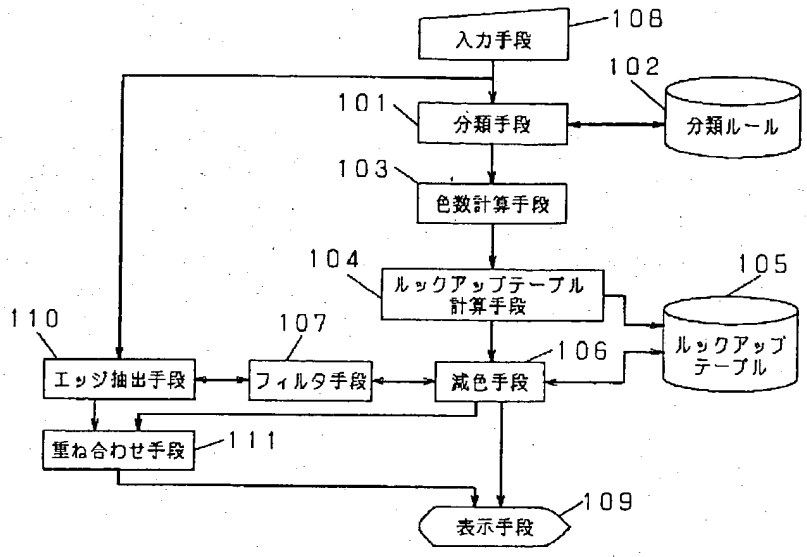
【図１０】


画像入力
701
ルックアップテーブル初期化
702
分類ルールを適用し、分類手段にて、入力画像の各々の画素を、属性値で分類
703
入力画像の各々の画素を複数個の属性値で分類する必要があるか？
704
707
色数計算手段にて、属性値が同じ画素で構成された画素群に割り当てる色数をそれぞれの属性値について計算
705
入力画像に対するルックアップテーブルを作成
それぞれの属性値に割り当てられた色数に応じて、属性値の数だけルックアップテーブルを作成
708
706
ルックアップテーブルを参照し、減色手段で減色処理を実行
それぞれの属性値毎に作成されたルックアップテーブルを参照し、同じ属性値を持つ画素の減色を、減色手段にて実行
709
フィルタ手段にて雑音成分を除去
710
減色画像表示
711

【図１１】


(a)
(b)
(c)
(d)
201
202
203
Na
Nb

【図１２】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分類手段
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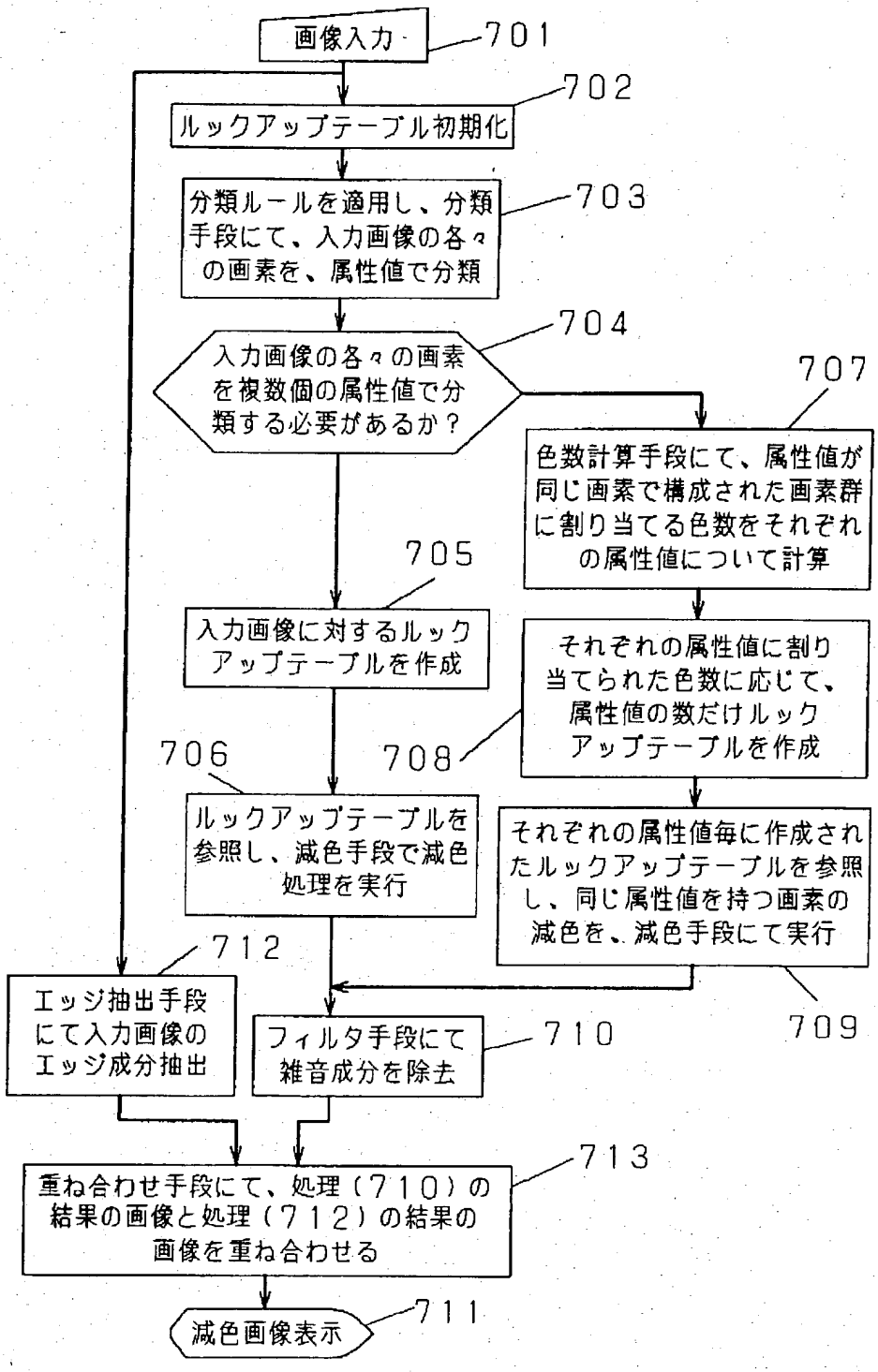
【図１３】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